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SALT WATER DETECTION IN THE CIMARRON TERRACE, OKLAHOMA

Oklahoma Water Resources Board
Oklahoma City, Oklahoma

April 1975

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APRIL 1975

SALT WATER DETECTION
IN THE
CIMARRON TERRACE, OKLAHOMA

by

Oklahoma Water Resources Board
2241 N.W. 40th Street
Oklahoma City, Oklahoma 73112

Grant S-800994
Program Element 1BA024
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Project Officer

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ABSTRACT

The objectives of this project were to demonstrate the applicability of surface resistivity techniques to delineate salt water contamination in a shallow alluvial aquifer, to outline areas of salt water contamination in a valuable terrace aquifer, to permit safe future development, and to identify the sources of such contamination.

Surface resistivity using the Wenner spread and both Barnes layer and apparent resistivity interpretive methods was found useful in outlining areas of major water quality changes where the geologic environment was simple and the terrace composed of sand. However, where clay was present in the terrace or where the bedrock relief was large, surface resistivity was not found to be an accurate definitive tool.

Two large areas of salt water contamination were intensively studied by test drilling. In one of these areas resistivity was extensively used. Brine contamination of one of these areas was attributed to oil field brine evaporation pits while the other area was contaminated by natural brines from the underlying bedrock. The sodium/chloride ratio was used to identify the source of brines.

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CONCLUSIONS

By using surface resistivity techniques, test drilling, and sodium/chloride ratios in terrace deposits of the Cimarron River in northwestern Oklahoma, the following conclusions can be made concerning groundwater in that area.

1. Two areas of widespread salt water contamination and numerous instances of localized contamination were delineated in the Cimarron Terrace.
2. In the large contaminated area near Crescent, the source of the salt water is from oil-field brines which were allowed to seep into the terrace sands through evaporation pits.
3. In the large contaminated area near Dover, the source of contamination is naturally occurring salt water in the Permian bedrock formation underlying terrace deposits.
4. Surface resistivity can serve as a valuable exploration tool in delineating salt water pollution in a shallow aquifer, but its usefulness decreases markedly where the geology is complex or where significant clay and silt is present in the zone of interest.
5. The sodium/chloride ratio has proven to be a valuable method for distinguishing natural salt water pollution due to the dissolving of halite in the formations from pollution caused by disposal of oil-field brines.
6. A large amount of time, on the order of 100 years or more, will be required before the salt water is flushed from the terrace under natural flow gradients.

RECOMMENDATIONS

Although surface resistivity was shown to be effective in delineating salt water contamination in a shallow alluvial aquifer in a simple geologic environment, its effectiveness diminishes as the geology grows more complex. It is recommended, therefore, that additional work be aimed at developing new methodology to meet these exploration needs; and that new interpretive methods be explored to render surface resistivity more definitive in complex geologic environments. Until a more effective surface geophysical method is developed, down-hole logging should be used in conjunction with test holes to establish water salinity. Although this approach requires extensive drilling, water sampling is limited to control points only, thereby reducing overall costs.

The water monitoring wells established under this project should be periodically sampled to form a record of the rate of flushing of the salt from the aquifer and to monitor spreading of the contamination.

The Oklahoma Water Resources Board should restrict large groundwater withdrawals in the vicinity of the contaminated areas in order to minimize the movement of salt water into uncontaminated areas. In areas of oil-field brine pollution, salt water should be allowed to flow under the natural hydraulic gradient and to discharge into the Cimarron River. Where contamination is caused by naturally occurring salt water from the underlying bedrock formations, withdrawal of the overlying fresh water should be somewhat restricted in order to avoid induced infiltration of the salt water from below.

Finally, it is recommended that a more intensive salt water disposal policing program be initiated by appropriate state agencies. Although unlined salt water evaporation pits for the disposal of oil-field brines are prohibited in the State of Oklahoma, several were observed during the field work on this project. As demonstrated by this project, such pollution restricts use of that part of the aquifer for many generations.

INTRODUCTION

GENERAL

Throughout the United States, local instances of groundwater contamination by brines have occurred. Such contamination has resulted from: salt water intrusion in coastal areas induced by overpumping freshwater; groundwater movement over natural bodies of halite; improper disposal of oil-field or other industrial brines; and the application of salts used in highway deicing.

Determining the areal extent of salt water contamination in an aquifer is fundamental for establishing control measures and for proper groundwater management criteria for utilizing uncontaminated portions of an aquifer.

Two general approaches exist for determining the areal extent of salt water pollution in aquifers. Collecting water samples from existing wells and drilling test holes from which water samples are taken constitute a direct approach. An indirect approach is the use of geophysical methods to measure some parameter related to the presence or absence of salt in the groundwater. If such an indirect approach can be successfully demonstrated, considerable time and money can be saved.

There is an additional need to develop methodology for identifying the source of salt water contamination so that sound measures can be taken.

The purpose of this study, therefore, is to demonstrate the applicability of surface resistivity techniques in delineating and quantitating salt water contamination of shallow fresh aquifers and to develop a method of identifying the source of such contamination on the basis of chemical analyses.

PROJECT AREA DESCRIPTION

The Cimarron Terrace, in northwestern Oklahoma, was selected in which to carry out this study. As shown in Figure 1, the terrace extends some 110 miles along the north side of the Cimarron River. It ranges in width from one to fifteen miles and ranges up to eighty feet in depth in some of the buried river channels that it covers.

Numerous towns, a growing number of irrigated farms, and thousands of households depend on the terrace for their water supplies. Because of the importance of the terrace as a fresh water source in the area and because of the salt water pollution known to exist, it is well suited for this study.

Considerable work has been done by others which relates to the project area and has been used to formulate the design of this project.

Water well inventories were provided by Gould[1] and the State Mineral Survey by the Works Progress Administration.[2] Groundwater availability was discussed by Locke, Kopp, and Reed[3] and in a map-report by the U. S. Geological Survey.[4] Schwennesen[5] also discussed availability in a report on irrigation.

Renick[6] discussed groundwater quality from wells and springs and Schoff[7] discussed both quality and quantity of groundwater in the terrace deposits.

The Oklahoma Water Resources Board, in cooperation with the U. S. Geological Survey,[8,9] made a detailed study of the

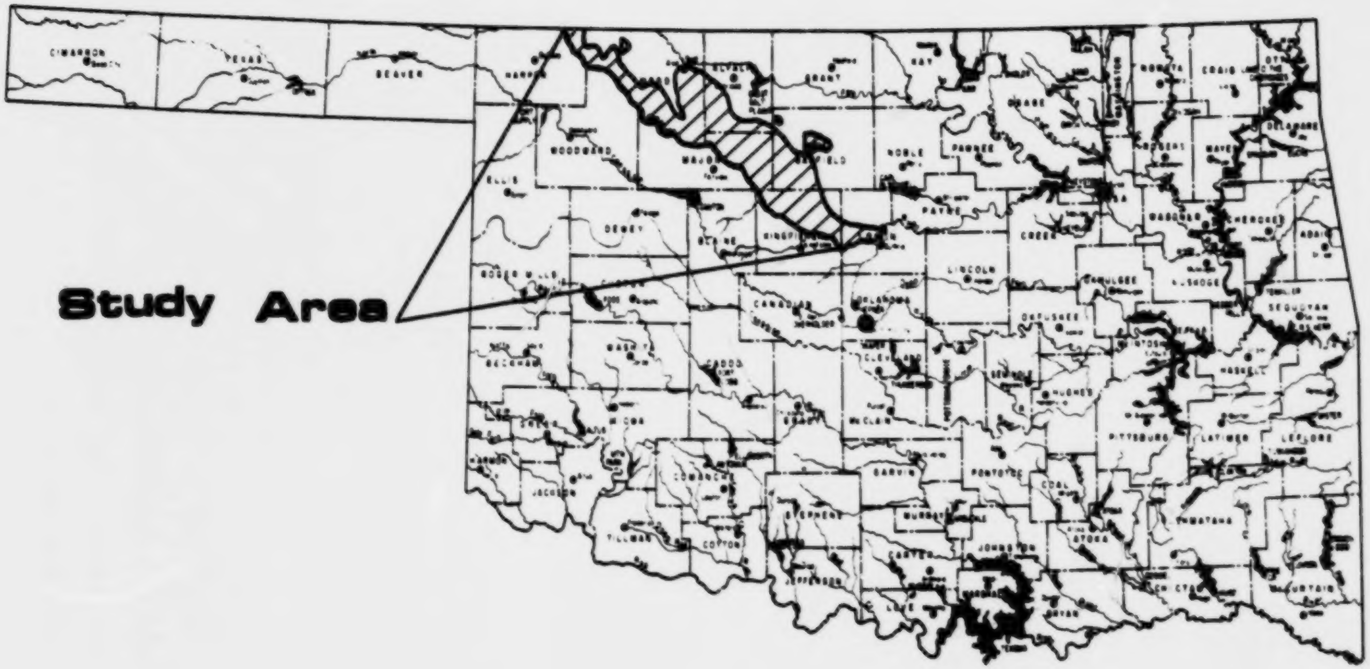


Figure 1 Location Map showing the location of the Cimarron Terrace in the State of Oklahoma

occurrence, quantity and quality of groundwater in both the terrace deposits and underlying bedrock. The study also discussed the feasibility of withdrawing large quantities of water from the terrace for public, industrial, and irrigation uses.

Renick[9] and Kite[10,11] published maps showing terrace deposits in parts of the area and discussed their lithology, origin, and thickness. Clifton[12,13] and Clark and Casper[14,15] also addressed terrace deposits in part of the project area by discussion or inclusion in geologic maps. Fay[16,17,18] discussed the Permian redbeds, Pleistocene sediments and salt deposits of the Flowerpot shale formation in part of the project area.

The Cimarron River has a total drainage basin area of 18,922 square miles from its origin in New Mexico to its confluence with the Arkansas River. Less than 7,000 square miles lie within the study area. The streambed is mostly flat and sandy with dense growths of salt cedar and cottonwood along its immediate banks. The river at Guthrie has a 33-year average annual flow of 624,560 acre-feet and ranges from a maximum of 158,000 cfs to a minimum of 0.1 cfs.

Along the southwest side of the river, the tributaries drain from gypsum bluffs across gently rolling land underlain by shale. Most streams flowing from the southwest are mineralized because of the bedrock formation over which they flow. Drainage along the southwest bank is well developed compared with drainage along the northeast bank of the river.

Within the study area, the land immediately north of the Cimarron River is marked by sandy soils and drifting windblown sand and is commonly known as the Cimarron Terrace.

Surface topography is dominated by generally stable sand dunes close to the river, and by gentle undulating to flat prairie-like surfaces farther back from the river. Surface drainage is generally poor. Only four streams originating outside the area flow southward across the terrace to the river. These four streams and several smaller streams lying entirely within the terrace are perennial in their lower reaches where flow is maintained by seepage from terrace deposits.

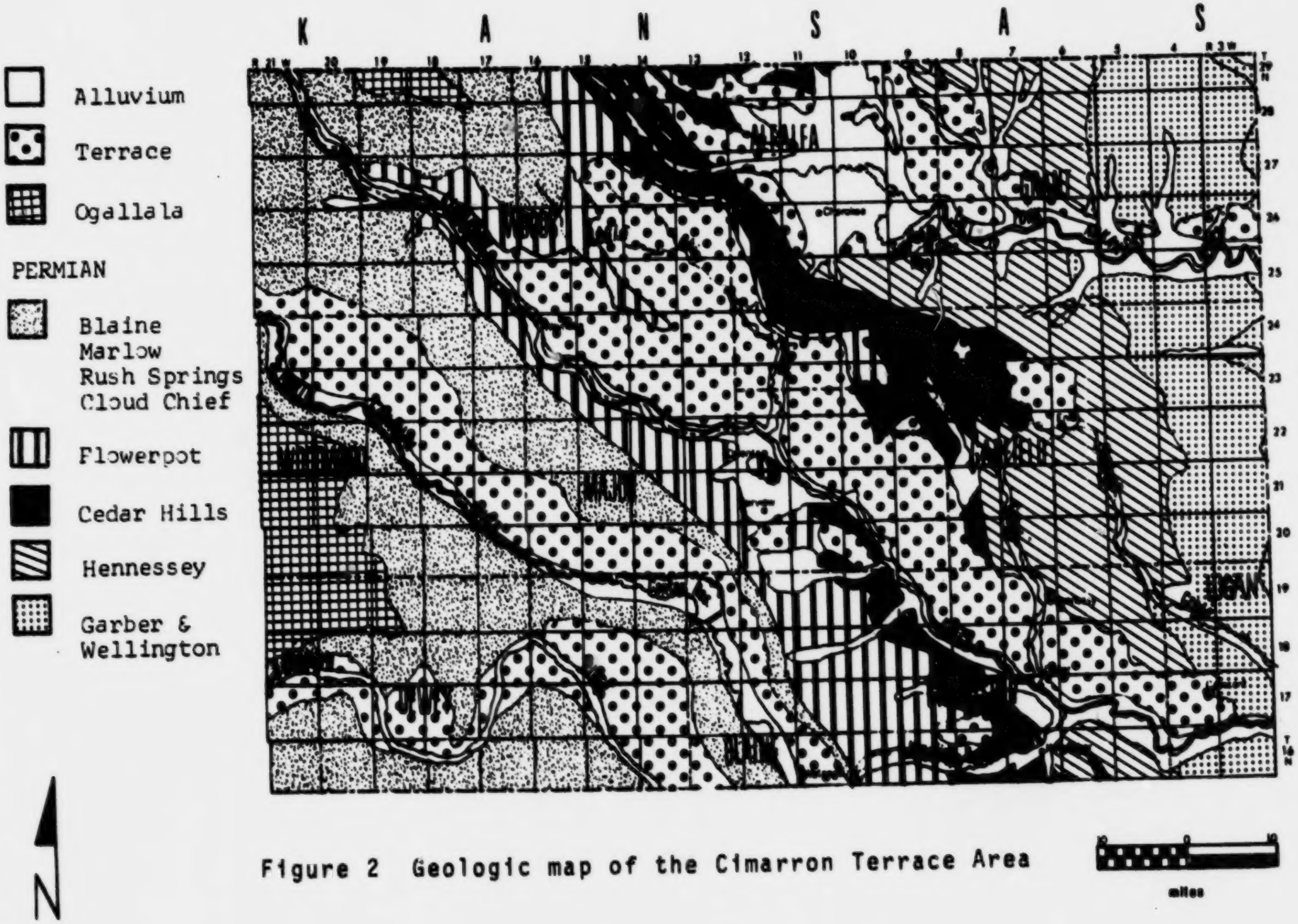
The average annual precipitation in the study area ranges from 30 inches in the southeast to 24 inches in the northwest. The poor surface drainage from the terrace, due to the highly permeable sandy soils, enhances its value as a fresh water aquifer. Even though the amount of water in storage is not great compared with a thicker aquifer, rapid recharge allows considerable development.

GEOLOGY OF AREA

Surface rocks of northwestern Oklahoma are assigned to the Permian System. These rocks form a redbed clastic-and-evaporite sequence that strikes generally in a northwest direction and dips gently southwestward about 10 feet per mile. Outcrop areas of the bedrock formations and the terrace area are shown in Figure 2. Quaternary sediments which comprise the Cimarron Terrace and the alluvium of the Cimarron River system rest upon the Permian redbeds.

The Permian formations crop out under and adjacent to the Cimarron Terrace in northwesterly trending bands with the oldest formation found at the southeast end of the terrace.

The oldest Permian unit which crops out beneath the Cimarron


K A N S A S
Alluvium
Terrace
Ogallala
PERMIAN
Blaine
Marlow
Rush Springs
Cloud Chief
Flowerpot
Cedar Hills
Hennessey
Garber &
Wellington
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GARFIELD
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Figure 2 Geologic map of the Cimarron Terrace Area

Terrace is the Garber formation. From the east end of the study area southward, the Garber is red, fine-to-medium grained sandstone with interbedded siltstones and shales. Progressing northwesterly, the formations become progressively younger. Above the Garber is the Hennessey formation, which is predominately a red shale with minor siltstone and sandstone lenses. The upper part of the Hennessey becomes increasingly sandy toward the north and northwest becoming the Cedar Hills member of that formation. The Cedar Hills is a reddish-orange, fine-grained quartz sandstone which grades into shale and siltstone toward the west. In the subsurface, the Hennessey grades into an evaporite sequence called the Cimarron evaporites.[18] These evaporites include the Lower Cimarron salt, Cimarron anhydrite, and the Upper Cimarron salt. The eastern extent of these salts passes through the center of Alfalfa County, across Major County, and along the western edge of Blaine County. These evaporites are from 300 to more than 1,000 feet below the surface and attain a total thickness of more than 1,000 feet.

The El Reno group rests on the Cedar Hills. This group of sediments is composed of the Flowerpot shale, Blaine formation and Dog Creek shale (ascending order).[18] The Flowerpot shale is a red-colored unit with fine-grained sandstone and siltstone lenses. Jordan and Vosburg[19] recognize a Flowerpot salt facies which has an eastern limit that extends across the western third of Woods County, and the northwestern corner of Major County near the northwestern end of the Cimarron Terrace. The salt in this area is less than 100 to more than 500 feet below the surface and can be more than 350 feet thick. Ward[20] suggests that a 57-foot bed of rock salt (sodium chloride) occurs beneath the Cimarron River bed near the northern end of the terrace. The Blaine formation overlies the Flowerpot shale and is an alternating series of gypsum (anhydrite in the subsurface), dolomite and shale. The Dog Creek shale rests on the Blaine and is reddish-brown, silty shale which contains interbedded gypsum (anhydrite in the subsurface).

These Permian redbed-evaporite units that are described in the above discussion are part of the Cimarron Series and are more than 2,000 feet thick. It is within this series of formations that natural salt occurs which, in places, is brought to the surface by deep percolating groundwater.

Overlying the Dog Creek shale is the Whitehorse group which is assigned to the Custerian series.[18] The Whitehorse consists of the Marlow formation and Rush Springs sandstone (ascending). The Marlow is an orange, fine-grained sandstone which contains interbedded dolomite and gypsum. The Rush Springs is also an orange sandstone, but lacks the dolomite and gypsum interbeds.

Overlying all of these Permian units are the unconsolidated clays, silts, sands, and gravels of the Pleistocene Series which is assigned to the Quaternary System. These sediments form the Cimarron Terrace and range up to 120 feet thick. These unconsolidated sands and silts were deposited on an old erosional surface with buried valleys and ridges which, together with depositional changes from silts and clays to clean permeable sands, result in a wide range of well yields. Groundwater in many areas of the Cimarron Terrace is good fresh water resulting from the infiltration of precipitation which falls directly on the terrace. The groundwater gradient is generally southward with discharge to the Cimarron River.

The alluvium of the Cimarron River is also composed of unconsolidated sands, some gravel, and silt and clay lenses.

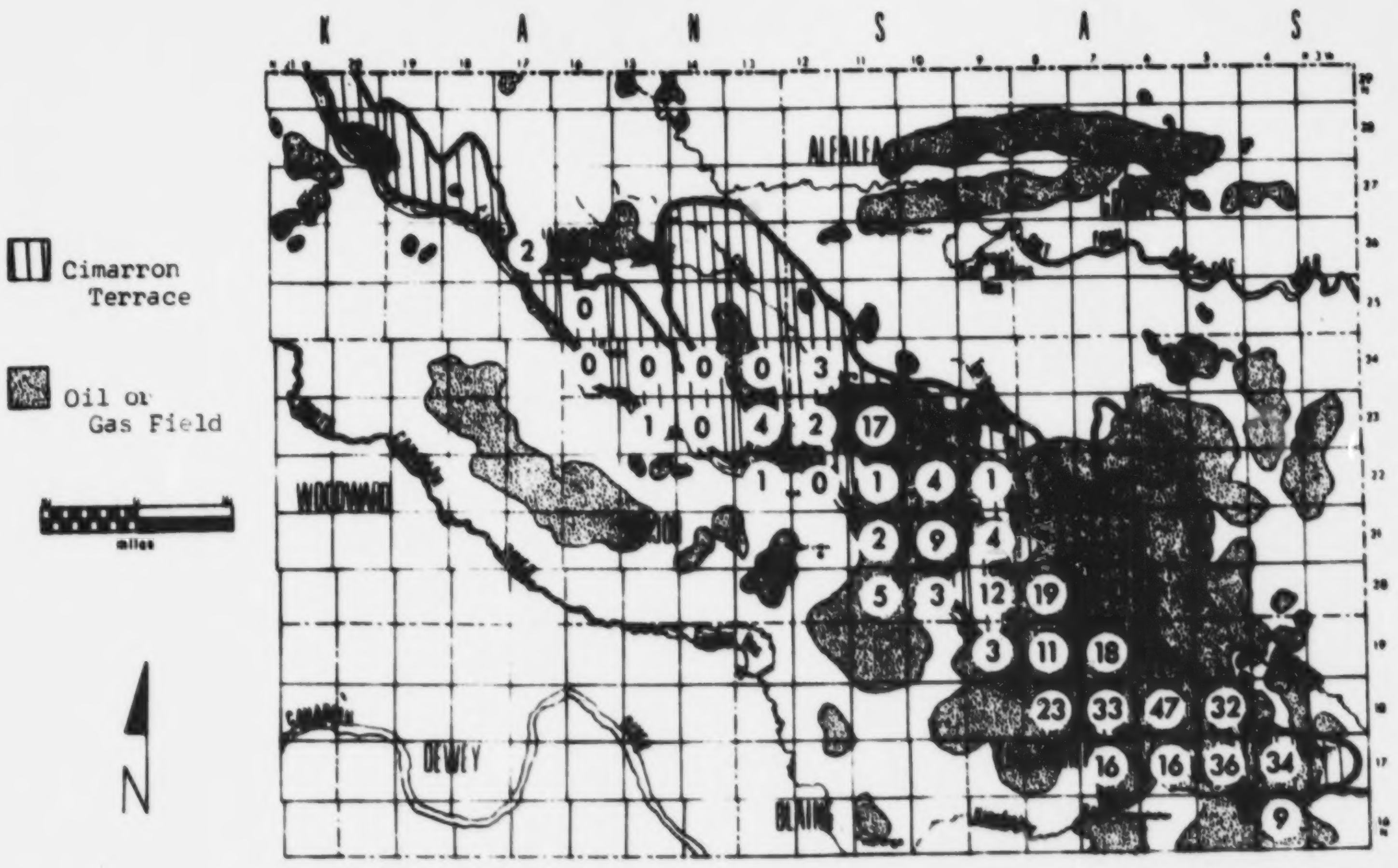
The alluvium, deposited in recent time, ranges in depth up to 50 feet and in many areas contains water high in salt content due to recharge by the salty river water during floods.

GROUNDWATER POLLUTION

Within the study area, two sources of sodium chloride pollution are known to exist. The first consists of bodies of natural salt (halite) deposited as lenses in the Flowerpot shale formation which outcrops in the northwestern part of the study area. Lenses of halite are common in the Flowerpot[18] shale but most of these within 600 feet of the surface have been dissolved by percolating groundwater. Occasionally, however, salt deposits still exist such as those constituting the Little and Big Salt Plains at the northwestern end of the Cimarron Terrace. The river acquires most of its salt load while flowing across this halite lense.

High sulfates are also characteristic of the Cimarron River water. The sulfates are derived from the gypsum and dolomite layers of the Blaine gypsum which overlies the Flowerpot shale.

The second source of contamination is caused by man. Figure 3 shows that many complaints, by residents of the area, have been filed with the Oklahoma Corporation Commission. A majority of these complaints have originated where oil and gas production is located in areas underlain by the more permeable part of the terrace near the river and where groundwater is more intensively developed. Oil and gas fields developed in recent years have caused fewer complaints because of more rigid safeguards against contamination.


KANSAS
ALFALFA
WOODWARD
DEWEY
BLAINE
Cimarron Terrace
Oil or Gas Field
miles
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2
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0 0 0 0 3
1 0 4 2 17
1 0 1 4 1
2 9 4
5 3 12 19
3 11 18
23 33 47 32
16 16 36 34
9

Figure 3 Number of salt water pollution complaints per township and locations of oil and gas fields

In the past, salt water separated from oil and gas was disposed of in large "evaporation" pits. Although some pits were correctly constructed of impervious material, or imperviously-lined, others were simply dug into permeable terrace sands allowing brines to percolate downward and contaminate the aquifer.

Numerous pits were used in this area between 1930 and 1950 when oil production was at its peak and before salt water disposal was effectively controlled. A great deal of the salt water contamination in the terrace is believed to be a result of pit disposal with the most widespread contamination being southwest of Crescent with other occurrences being much more limited in extent.

The locations of all waste disposal facilities now in use in the terrace are shown in Figure 4.

PROJECT THEORY

Surface resistivity methods and sodium/chloride ratios were selected to delineate salt water contamination and to identify the source of such contamination, respectively.

Present methods for making electrical soundings, now referred to as surface resistivity, have evolved over several decades of use in the fields of groundwater exploration, mining, engineering, geology, and oil exploration. Selected references are listed at the back of this book. The few attempts to use surface resistivity to delineate salt water-fresh water interfaces have shown promise in previous work but have not been consistently successful because of complicating geologic conditions. No known previously published reports are available of work using surface resistivity to delineate salt water in terrace deposits.

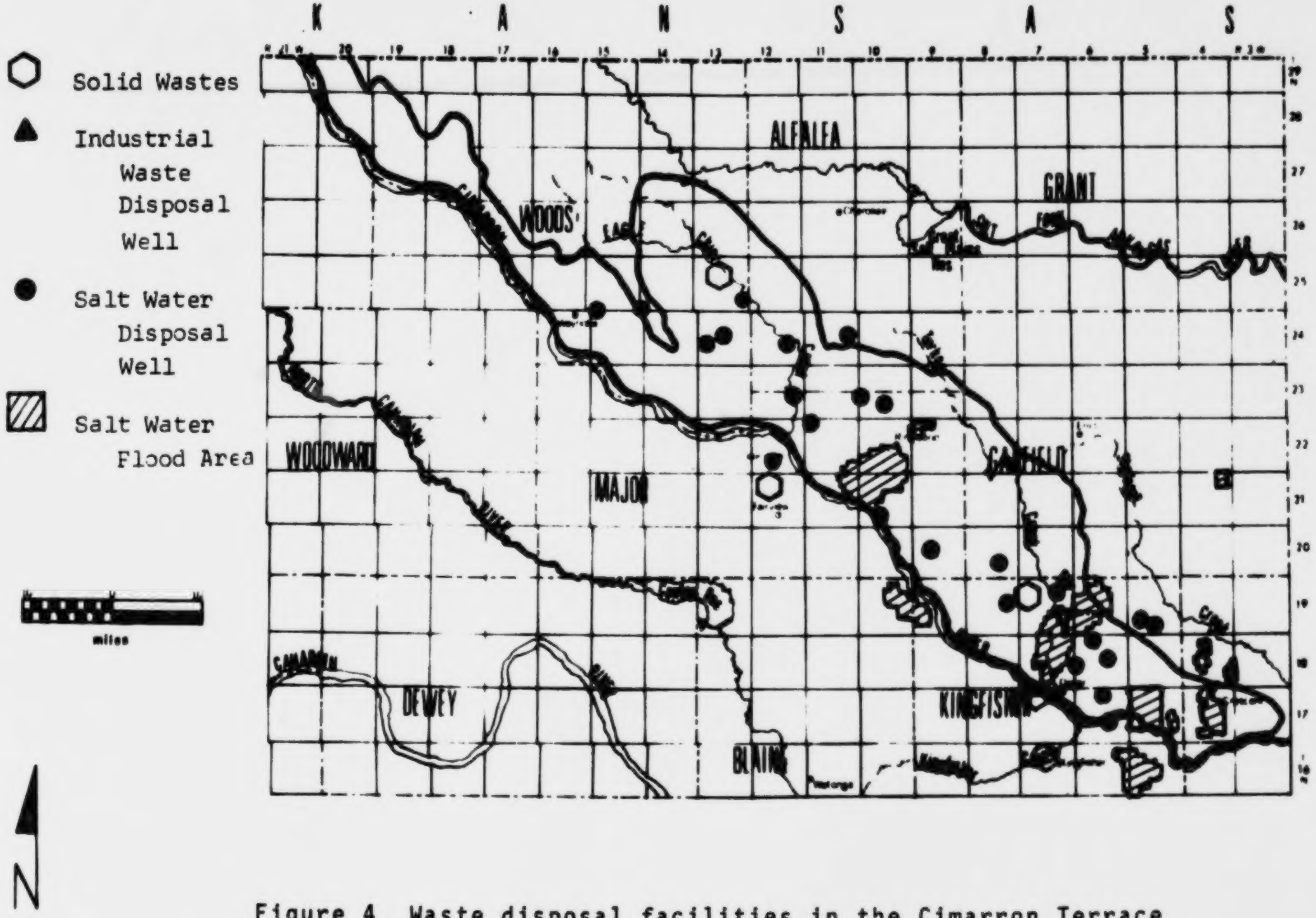
K A N S A S
Solid Wastes
Industrial Waste Disposal Well
Salt Water Disposal Well
Salt Water Flood Area
miles
N
ALFALFA
GRANT
WOODS
WOODWARD
MAJOR
GARFIELD
KINGFISHER
BLAINE
DEWEY
CIMARRON
RIVER

Figure 4 Waste disposal facilities in the Cimarron Terrace

Electric resistivity is a surface exploration tool long recognized and used in subsurface geologic exploration. The method employs a battery-powered instrument that forces a current to flow through the ground between two outer electrodes driven 1 to 2 feet into the ground, and measures the potential drop between two inner electrodes. One of the factors that can cause differences in resistivity is the salinity of the groundwater. A schematic of the electrode array is shown in Figure 5.

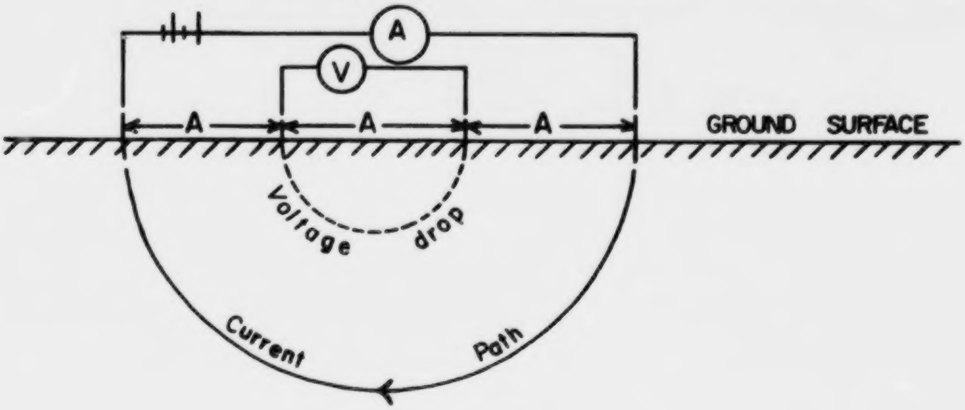

Figure 5 Schematic of electrical surface resistivity

By moving the electrodes farther apart but keeping the "A" spacing (distance between electrodes) equal for each reading, it is possible to evaluate changes in resistance to electrical flow, hence changes in earth materials, at increasing depths. The Wenner configuration (equal "A" spacing) was used for all the resistivity stations on this project. The electrical resistance of earth materials is affected primarily by the moisture content of the earth matrix and the conductivity of the water. Sands generally have a much higher resistivity than do clays mainly due to the relative quantity of water in these soil types.

A dry sandy soil has a high resistance, a sandy soil saturated with water containing a low concentration of soluble salts has relatively a medium resistance, and a sandy soil containing water with a high concentration of salts and clayey soils have a relatively low resistance to electric current.

Therefore, an electrical depth sounding should delineate the depth to the water surface in a water-table sand aquifer and should also reflect the dissolved solids content of the water in a vertically simple geologic environment, an electrical traverse of this nature should give information regarding lateral changes in water quality. Of course, in nature, the geologic environment is rarely ideally simple vertically and certainly not constant laterally, so that interpretation of resistivity data is usually quite complex.

Of the numerous interpretive methods available, two were selected as most applicable for determining a lateral change in water quality in a shallow aquifer. The first method is simply to plot the apparent resistivity values at a given "A" spacing at each station and to contour the lateral changes. The electrical properties of the near surface materials have a much greater effect on the total resistivity measured than the material at the depth equal to the "A" spacing, approximately double the depth of interest. The water table, in that part of the terrace studied intensively, averages about 20 feet below the surface, and the depth of the terrace averages about 40 feet; therefore, an "A" spacing of 80 feet was selected for the apparent resistivity map.

The second interpretation method is considerably more complex. First, the apparent resistivity data at a given station was corrected by a computer program using an unpublished technique developed by Keck Consulting Services, Inc. By using this technique each successive resistivity measured, as the "A" spacing is increased at a given station, is corrected to adjust for the resistivities of overlying materials. The corrected resistivity values were then used in the Barnes layer equation[21] (again by computer program to obtain Barnes layer values). In order to facilitate the use of this method, the "A" spacings were increased in 4-foot increments during the field work. The "A" spacing was increased to gain deeper penetration, but the space between electrodes was always equal for a given setting. As a result, Barnes layer values were obtained for each 4-foot layer of soil.

An inherent problem in interpreting surface resistivity data is the fact that surface soils and subsurface geologic strata change laterally, especially in an alluvial or terrace geologic environment. In addition, buried pipelines, ground currents induced by overhead transmission lines, and wire fences (all common in the study area) cause lateral changes in electrical properties which are difficult to differentiate from vertical changes. In order to minimize this problem, readings were frequently made first on the left set then on the right set of the four electrodes by using a fifth electrode in the center. This procedure, called Lee partitioning, is useful in identifying large lateral changes.

Where lateral changes in resistivity occur they sometimes result in "backups" in the data which especially affects the Barnes layer calculations. Normally the resistivity values decrease with depth (as the "A" spacing is increased). Lateral changes can cause a given resistivity value to be larger than the shallower value. When this "backup" occurs, then the Barnes layer value becomes negative and the technique is not valid. Even though the Lee partitioning technique was extensively employed during the field work, numerous instances were encountered in which "backups" resulted, making the Barnes layer method less useful.

PROJECT DESCRIPTION

A number of steps were taken to establish an information base to be used in selecting specific areas of investigation for this project.

In addition to examining the files of state agencies to locate previously known areas of chloride contamination, well publicized public hearings were held in several towns within the terrace to obtain current and historical data on chloride pollution and to acquaint residents with the project.

Water samples were obtained from several locations along the Cimarron River and analyzed for chlorides. As shown in Figure 6, a profile of water quality was constructed along the river. The slight increase in chloride and large increase in specific conductance near Dover results from high sulfate water entering the river from the south and not from the terrace.

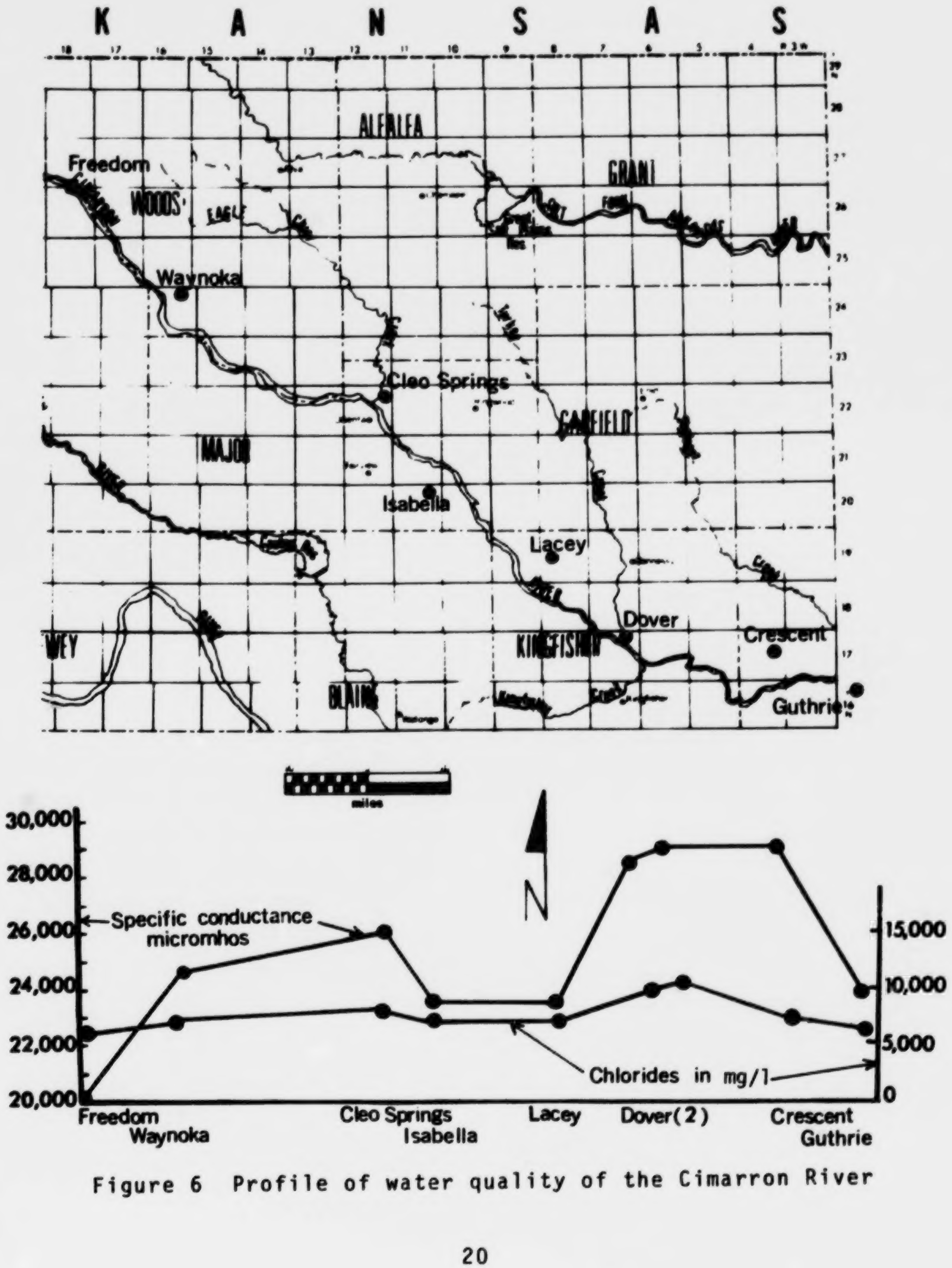

Figure 6 Profile of water quality of the Cimarron River

The results of these preliminary studies showed that the most extensive contamination exists in the Crescent area, and the second most extensive contamination exists near Dover. These areas are shown in Figure 7. Several isolated domestic and stock wells showing chloride contamination were located during this project but were not extensively studied.

Specific conductance of samples collected from existing water wells served as a general guide in locating surface resistivity profiles. In the Crescent area resistivity measurements were made at 162 stations, compared to 12 in the Dover area. Much of the resistivity was done prior to test drilling and served as a guide in locating test hole locations. Additional resistivity work was done during test drilling phases of the project at those locations so that correlations could be made.

A total of 125 test holes were drilled mainly in the Crescent and Dover areas. Fifty of these holes were cased to permit water sampling while in others borehole resistivity logs were run in order to estimate water quality. Some wells were drilled only for geologic control. Permanent monitoring stations were established at 34 sites.

The test drilling program provided a control for surface resistivity measurements as well as providing data for bedrock contour and chloride maps in the Crescent and Dover areas.

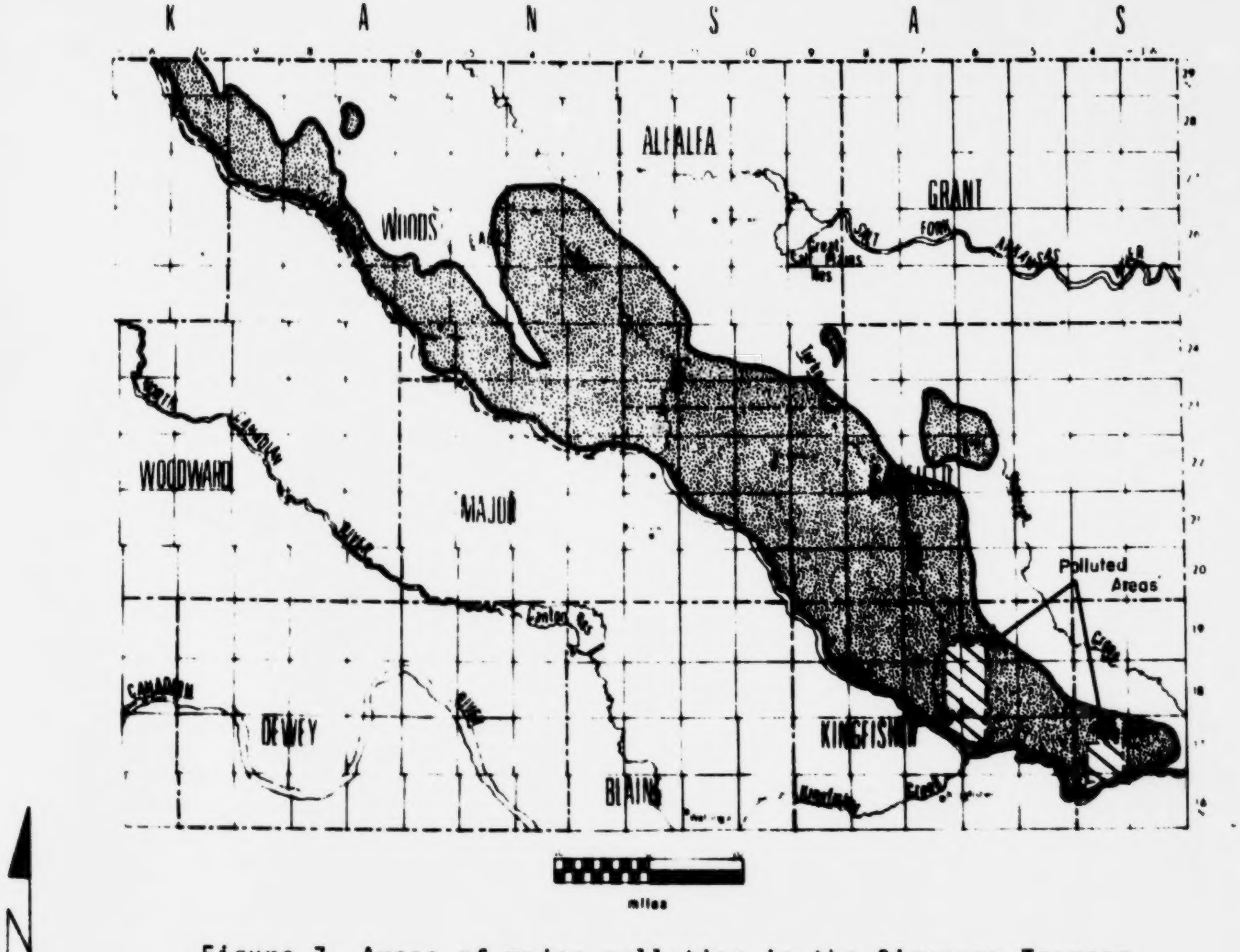
K A N S A S
ALFALFA
GRANT
WOODS
WOODWARD
MAJOR
DEWEY
BLAINE
KINGFISHER
Polluted Areas
SALT FORK
ARKANSAS
CANADIAN
RIVER
CANADIAN
miles
N

Figure 7 Areas of major pollution in the Cimarron Terrace

DISCUSSION

WATER QUALITY

The area southwest of Crescent, near the southeast end of the Cimarron Terrace, is the most extensive area of salt water contamination in the terrace. Groundwater, which was once fresh, has been rendered unfit for human consumption in a nine square-mile area.

Figure 8 shows the surface geology in the Crescent area where the terrace is extensive and potentially a significant water source. Figure 9 shows the locations of pre-existing wells and the test holes drilled under this project. Details of the wells and test holes are listed in Appendix A. The bedrock surface on which the terrace materials were deposited is very irregular showing the effects of erosion. The bedrock contour map shown in Figure 10 depicts this surface as interpreted from test hole data, and Figure 11 shows the thickness of the terraced deposits as determined from the bedrock contour map and the surface contour map. The orientation of the buried alluvial valleys plus groundwater gradients shown on Figure 12 provide important information regarding the direction and rate of movement of salt water in the terrace.

Water samples were obtained from most of the existing wells in the Crescent area and from some of the test holes. Details of the analyses of these samples are tabulated in Appendix B. Figure 13, 14, and 15 are interpretive maps showing the distribution of chlorides, total dissolved solids, and specific conductance. These maps show a consistent high concentration of contaminated water in section 34 with somewhat less contaminated water extending northward into section 27.

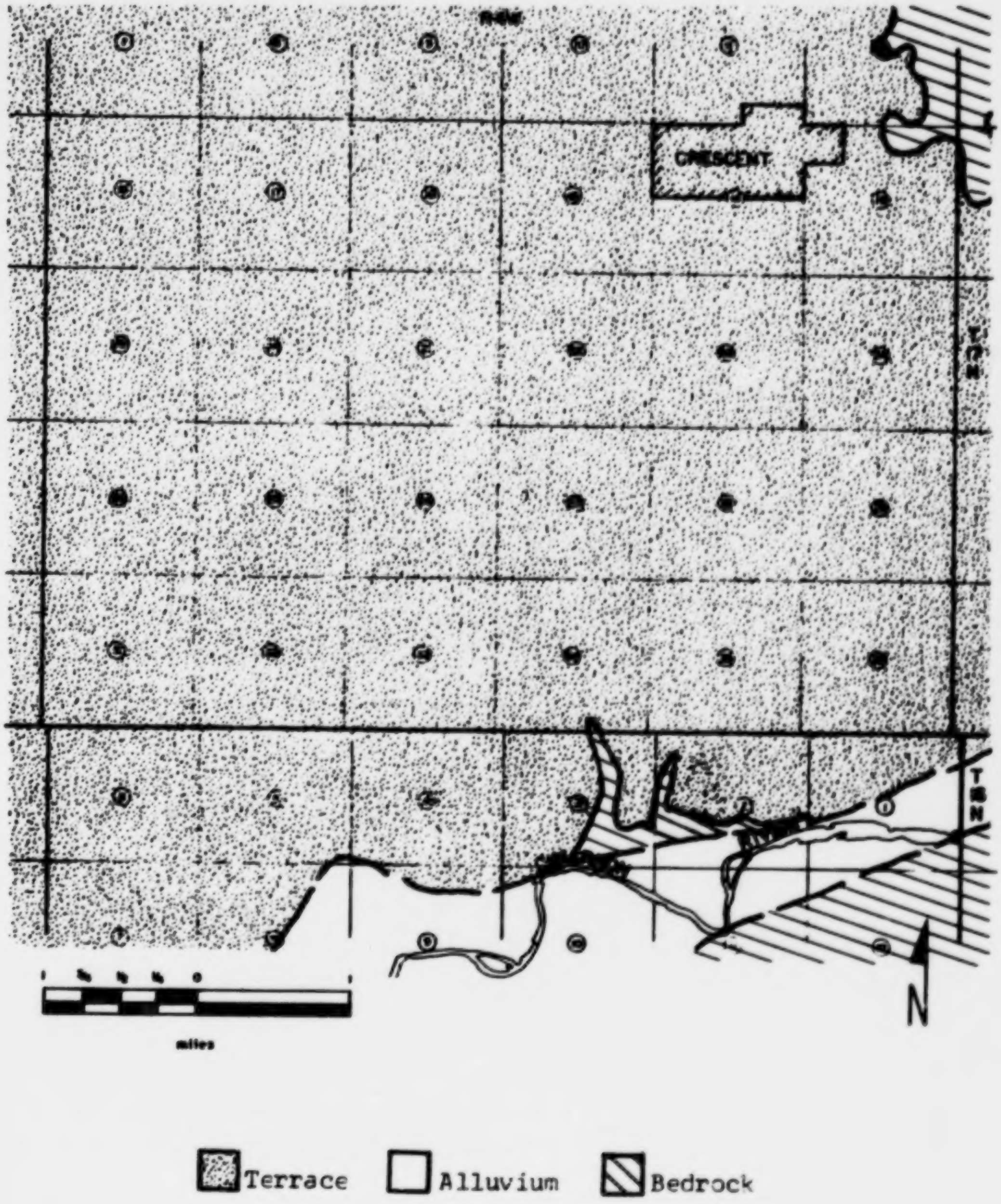
R-6W
CRESCENT
T17N
T16N
1 ¾ ½ ¼ 0
1
miles
N
Terrace
Alluvium
Bedrock

Figure 8 Geologic map - Crescent Area

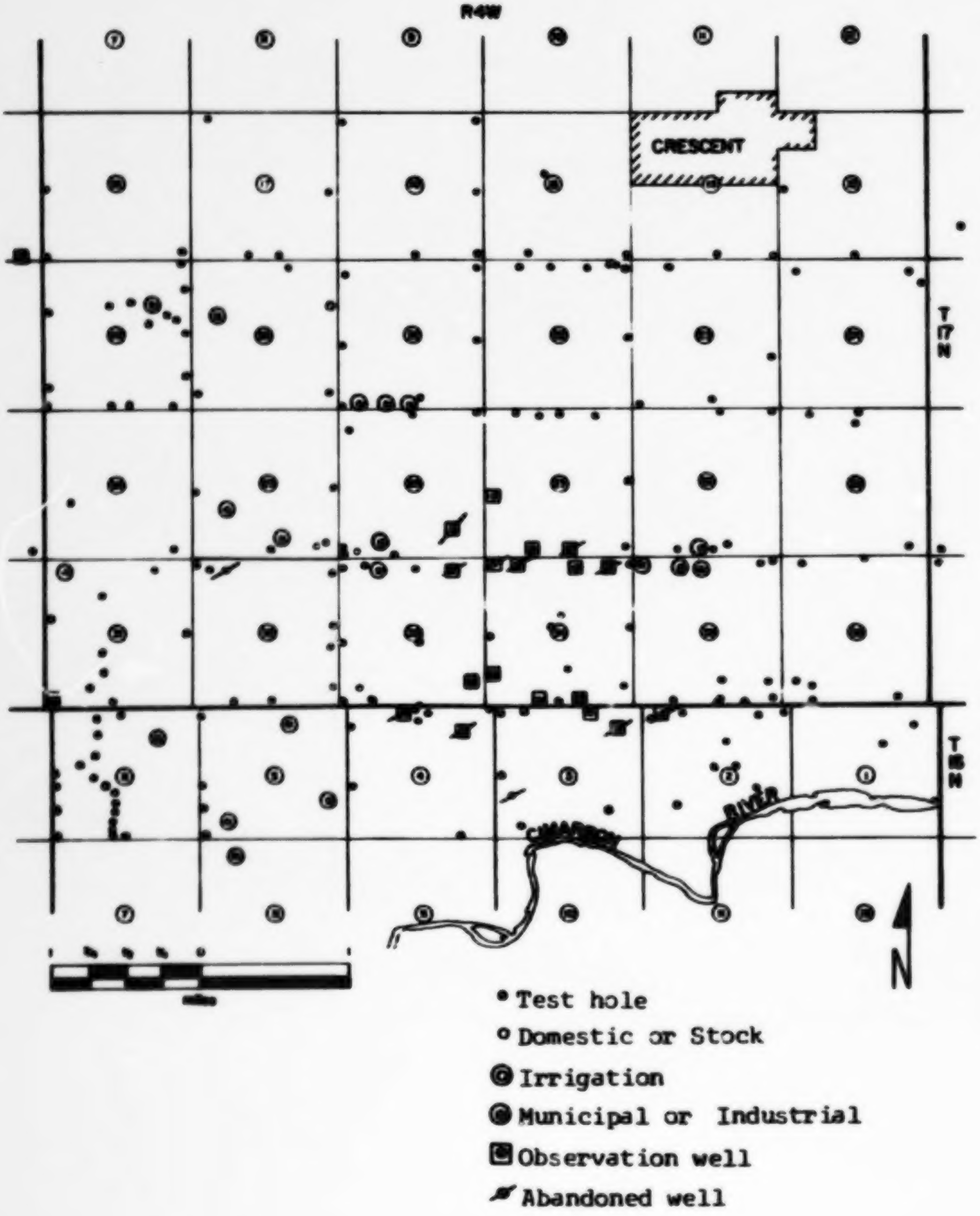
R4W
CRESCENT
T 17 N
T 16 N
CIMARRON
RIVER
N
miles
• Test hole
○ Domestic or Stock
◎ Irrigation
● Municipal or Industrial
▣ Observation well
Abandoned well

Figure 9 Well locations - Crescent Area

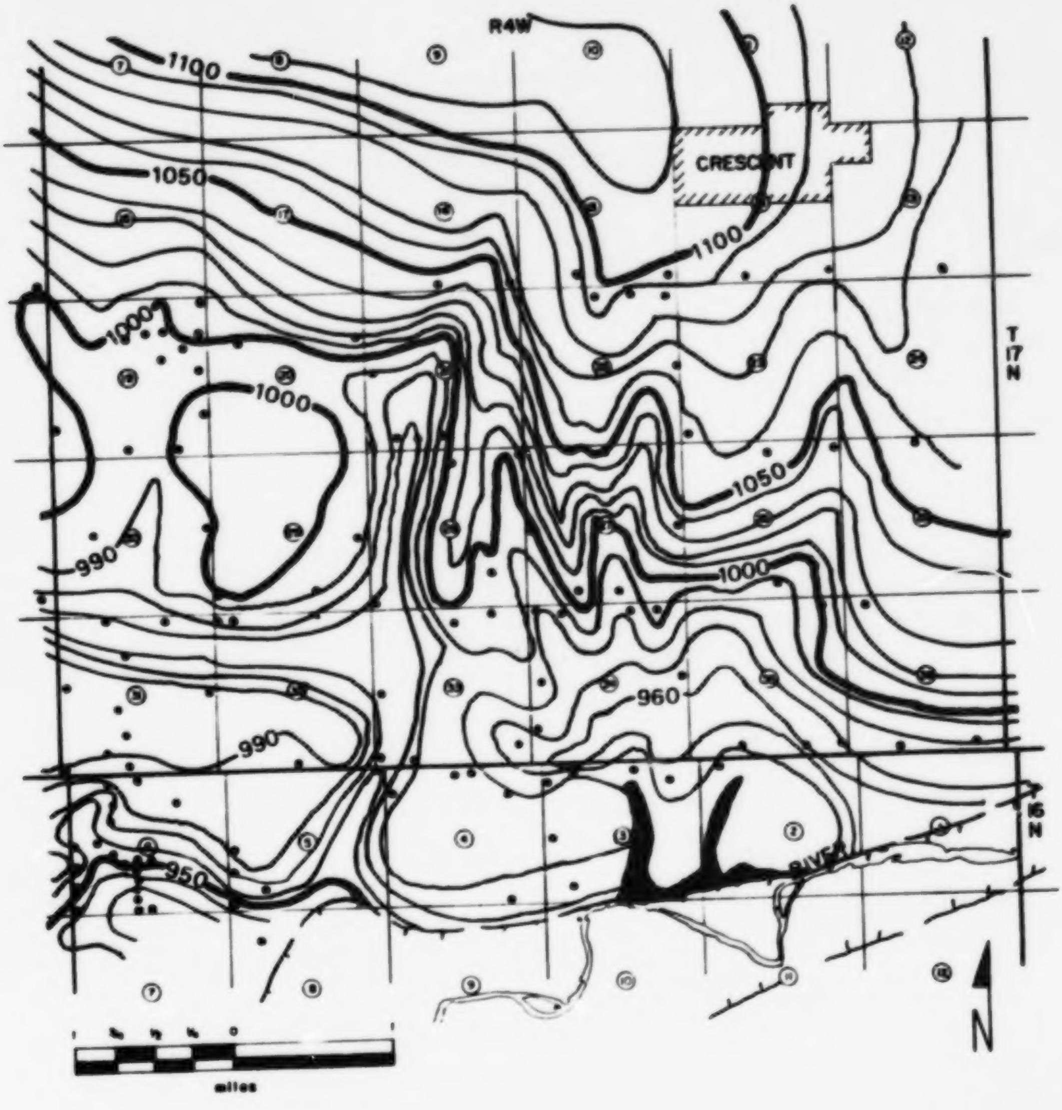
R4W
1100
1050
CRESCENT
1100
1000
1000
1050
990
1000
960
990
950
RIVER
T 17 N
T 16 N
N
miles

Figure 10 Bedrock contour map - Crescent Area (contour interval = 10 feet)

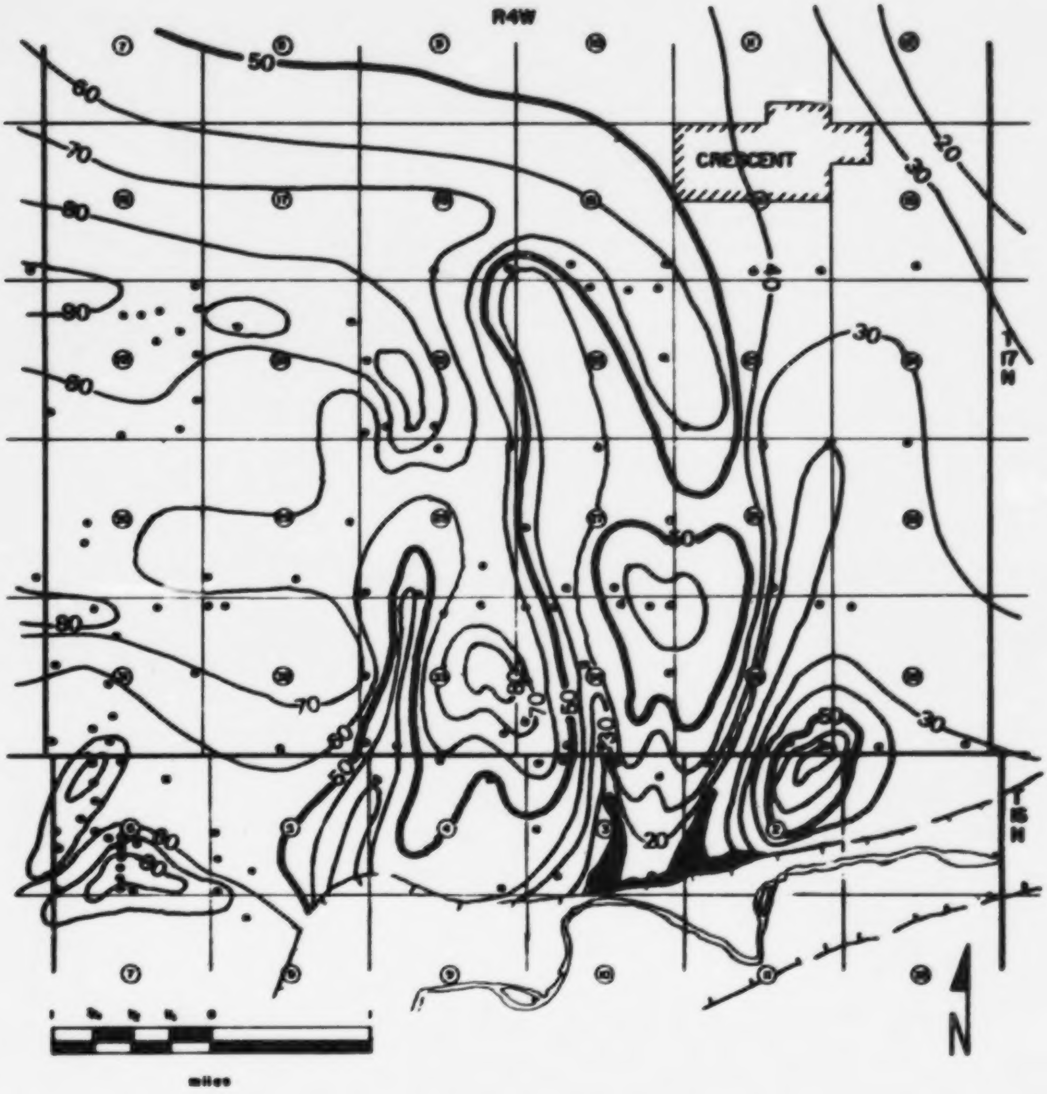
R4W
CRESCENT
50
60
70
80
90
80
40
30
20
30
60
80
70
60
50
80
70
50
30
20
50
30
80
80
T 17 N
T 16 N
N
miles

Figure 11 Isopach map - Crescent Area
(thickness of terrace deposits)
(Contour interval = 10 ft.)

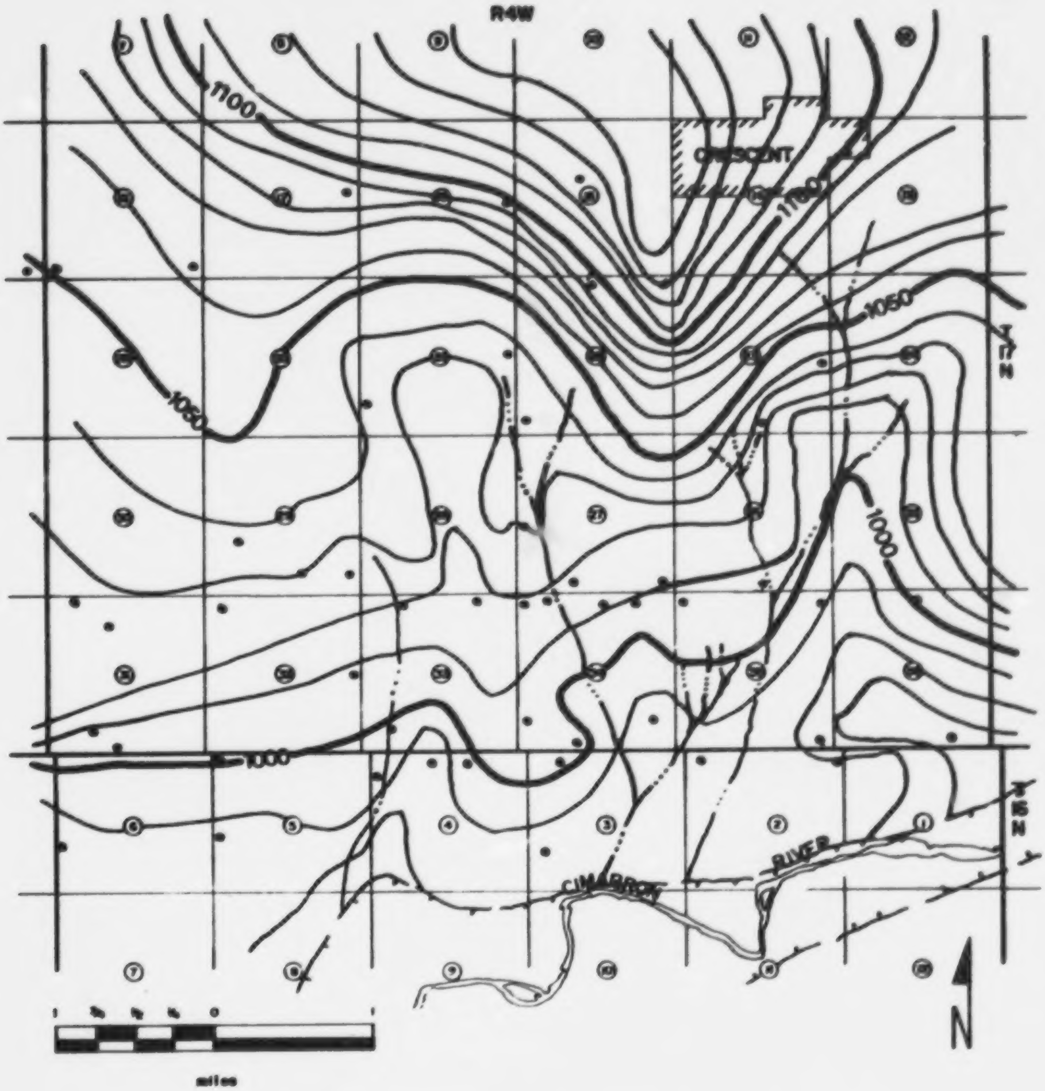
R4W
1100
CRESCENT
1100
1050
1050
1000
1000
T 17 N
T 16 N
CIMARRON
RIVER
N
miles

Figure 12 Water table contour map - Crescent Area
(contour interval = 10 feet)

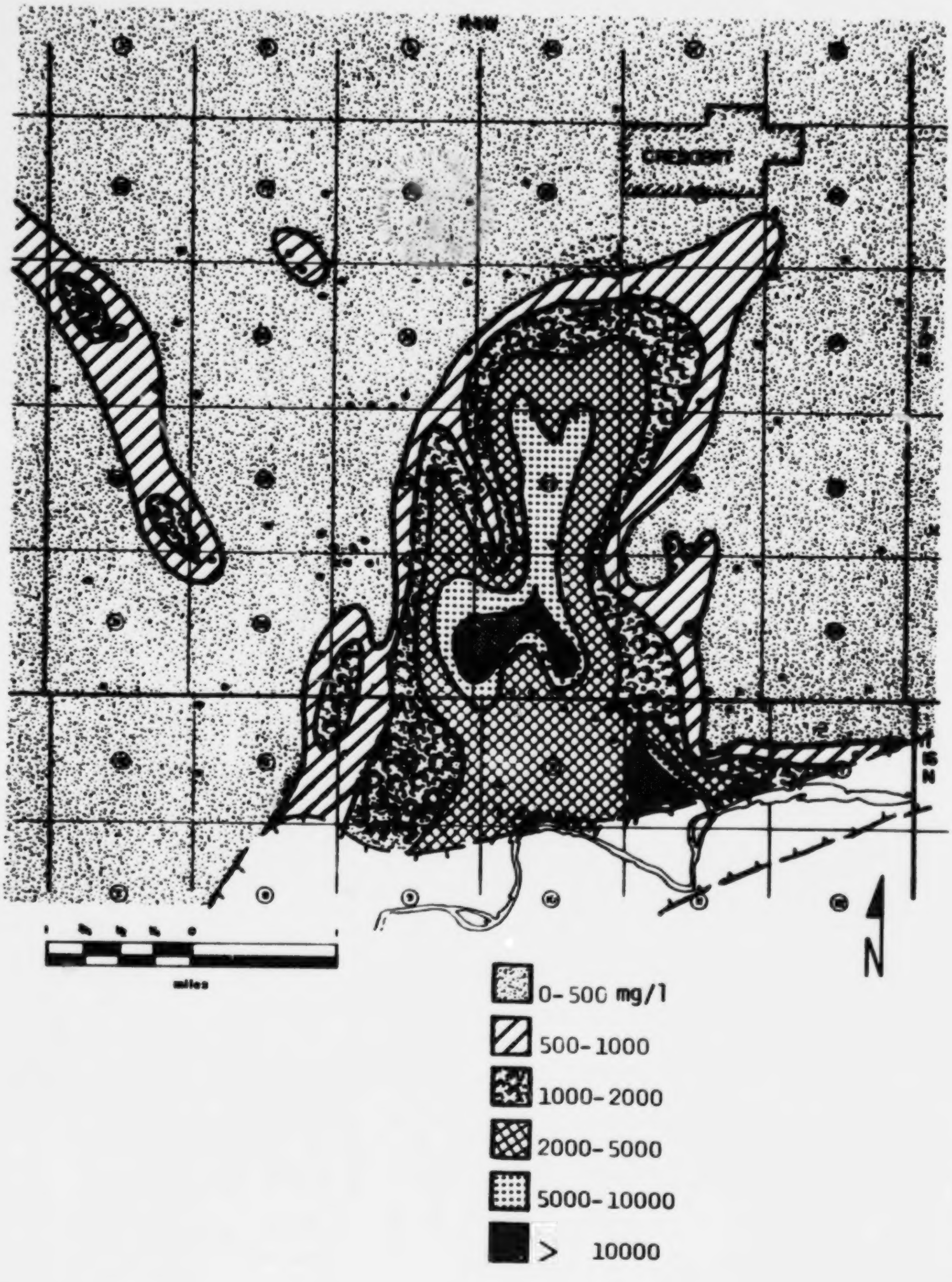
CRESCENT
N
miles
0-500 mg/l
500-1000
1000-2000
2000-5000
5000-10000
> 10000

Figure 13 Chloride content of groundwater - Crescent Area

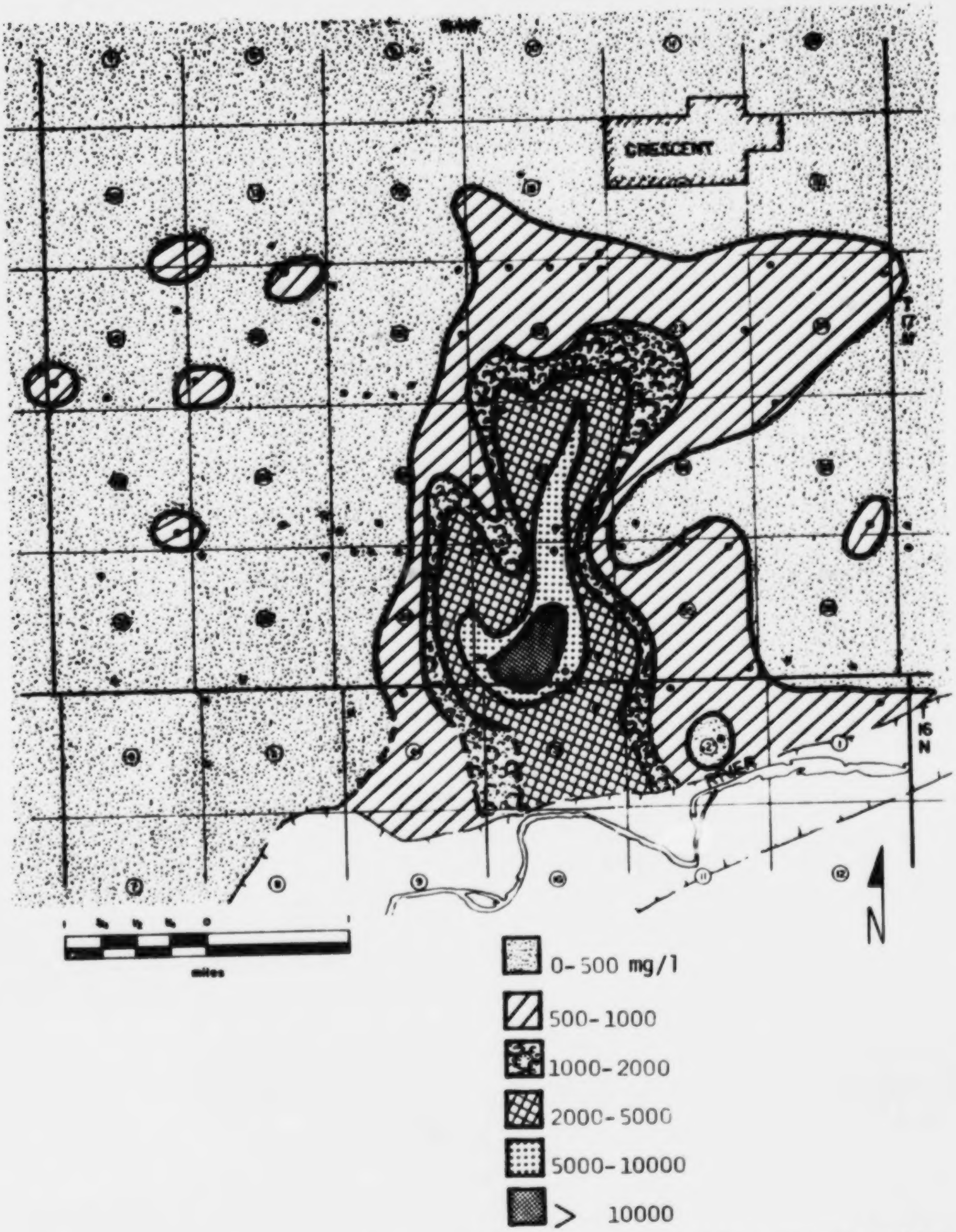
CRESCENT
T 17 N
T 16 N
RIVER
miles
N
0-500 mg/l
500-1000
1000-2000
2000-5000
5000-10000
> 10000

Figure 14 Total dissolved solids in the shallow groundwater Crescent Area

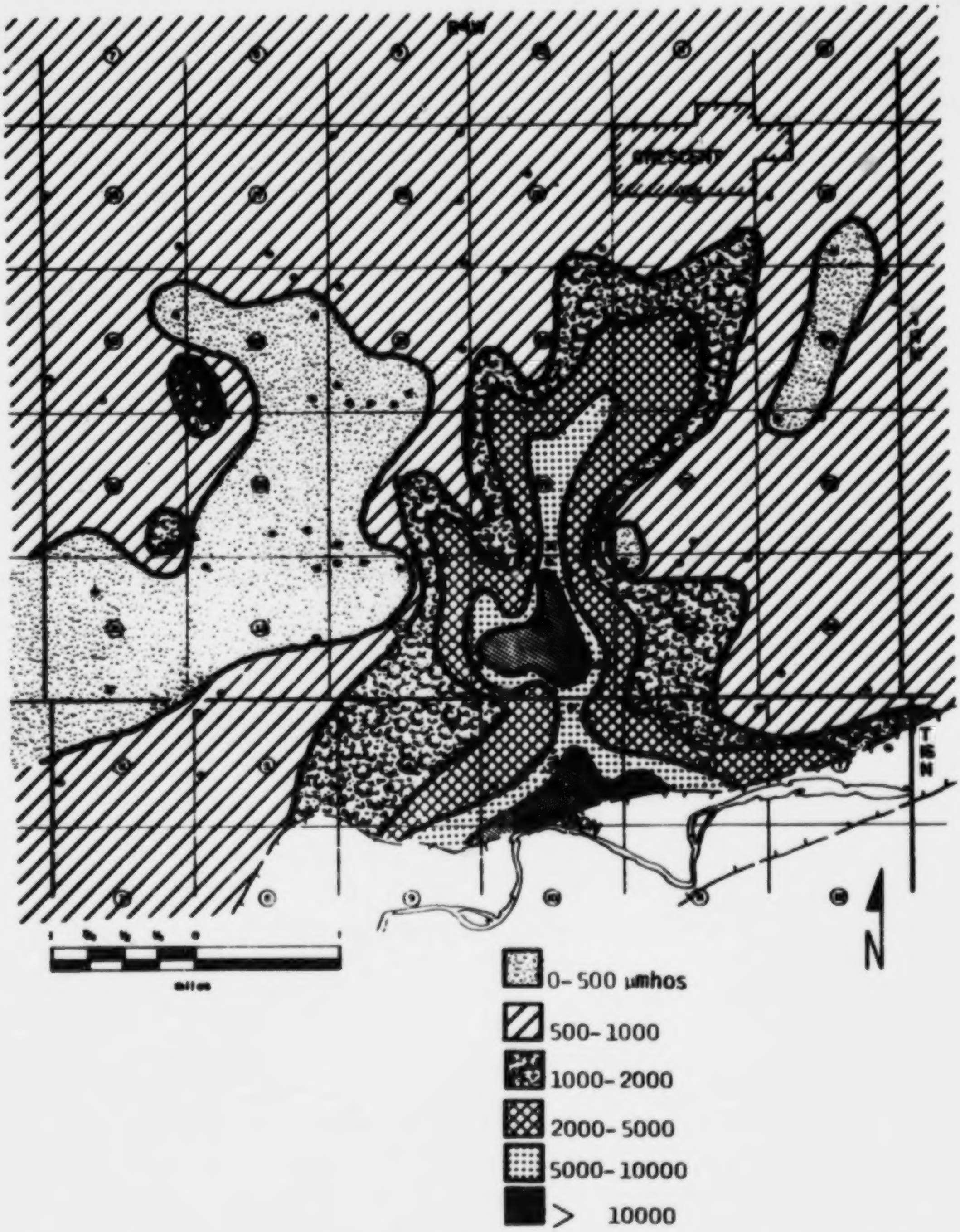
CRESCENT
T 16 N
N
miles
0-500 µmhos
500-1000
1000-2000
2000-5000
5000-10000
> 10000

Figure 15 Specific conductance of groundwater - Crescent Area

The Dover-Hennessey area is also in the southeast part of the terrace, about 17 miles west of the Crescent area. The extent of the terrace and underlying bedrock outcrops are shown in Figure 16. In this area, the Permian redbed formation underlying the terrace is the Cedar Hills member of the Hennessey shale. Southward, the Cedar Hills is composed mainly of red-to-brown siltstone with only a few sandy lenses.

As in the Crescent area, the bedrock surface in the Dover area underwent considerable erosion prior to the deposition of the terrace sands and silts. The locations of all wells used for control of the various interpretive maps is shown in Figure 17. Based on logs of existing domestic, irrigation and municipal wells, and test drilling done under this project, a contour map of the bedrock surface was prepared as shown on Figure 18. This map reflects the buried bedrock valleys and ridges which greatly influence the flow of groundwater. Generally, the terrace deposits consist of coarse clean sands in the bedrock channels and fine sands and silts on the ridges and high on the channel flanks. The water table contour map, Figure 19, reflects the influence of the bedrock channels and depositional pattern of the terrace deposits. A trough in the water table extending southeast from Section 30, Twp 18N, Rge 6W, shows a linearity in permeability which corresponds with the bedrock channel along the same alignment.

The distribution of the chlorides in the Dover-Hennessey area is shown on Figure 20, and the total dissolved solids are shown in Figure 21. Nearly all of the high chlorides are from domestic wells which were drilled below the terrace materials and into the Permian bedrock. Although considerable oil well drilling has taken place in this area, all of the wells have been drilled since 1960 and "evaporation" pits were not used for the disposal of salt water.

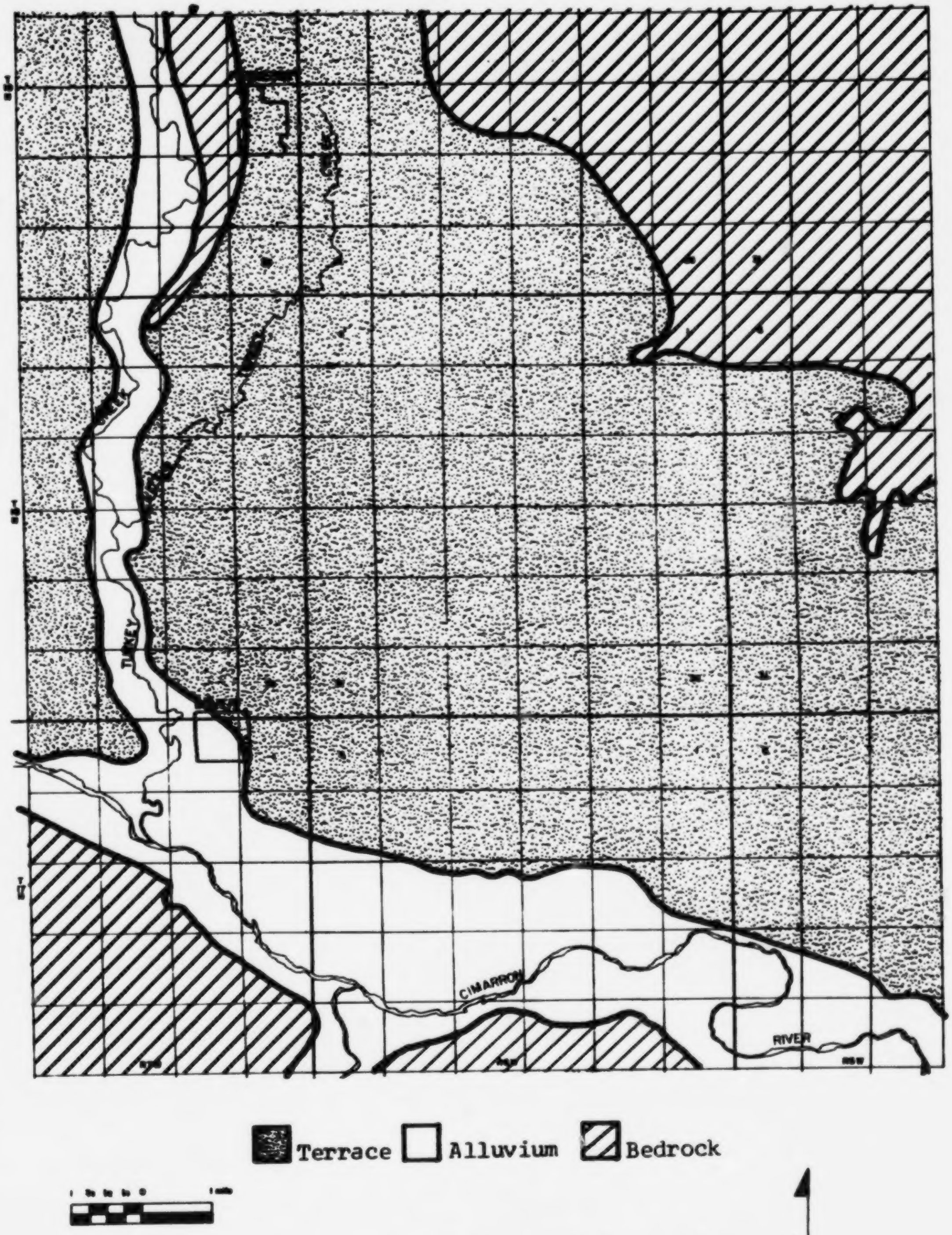
TURKEY
CREEK
CIMARRON
RIVER
Terrace
Alluvium
Bedrock
N

Figure 16 Geologic map - Dover Area

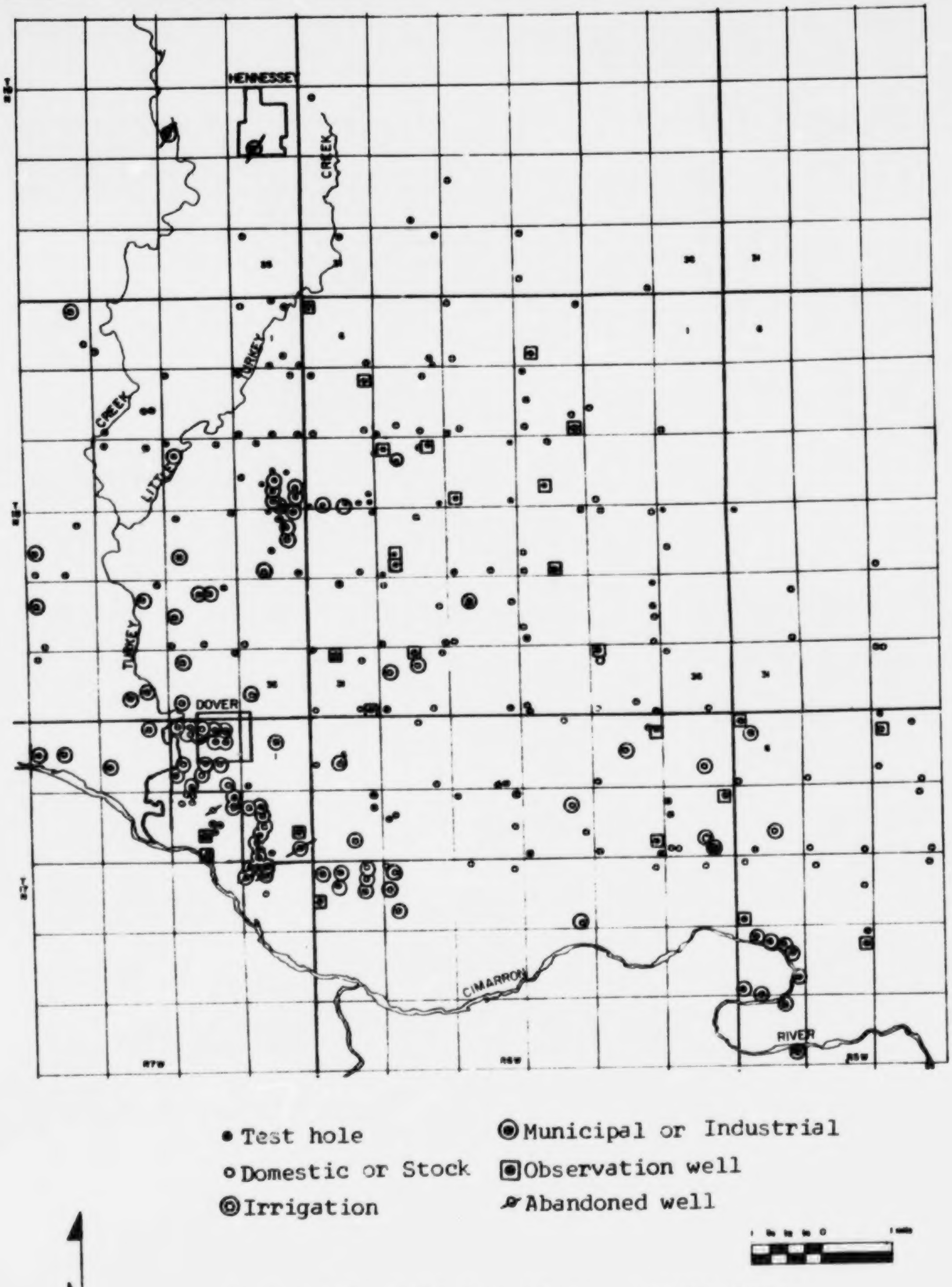
HENNESSEY
CREEK
TURKEY
CREEK
LITTLE
TURKEY
DOVER
CIMARRON
RIVER
R7W
R6W
R5W
● Test hole
○ Domestic or Stock
◎ Irrigation
◉ Municipal or Industrial
▣ Observation well
Abandoned well
N

Figure 17 Well locations - Dover Area

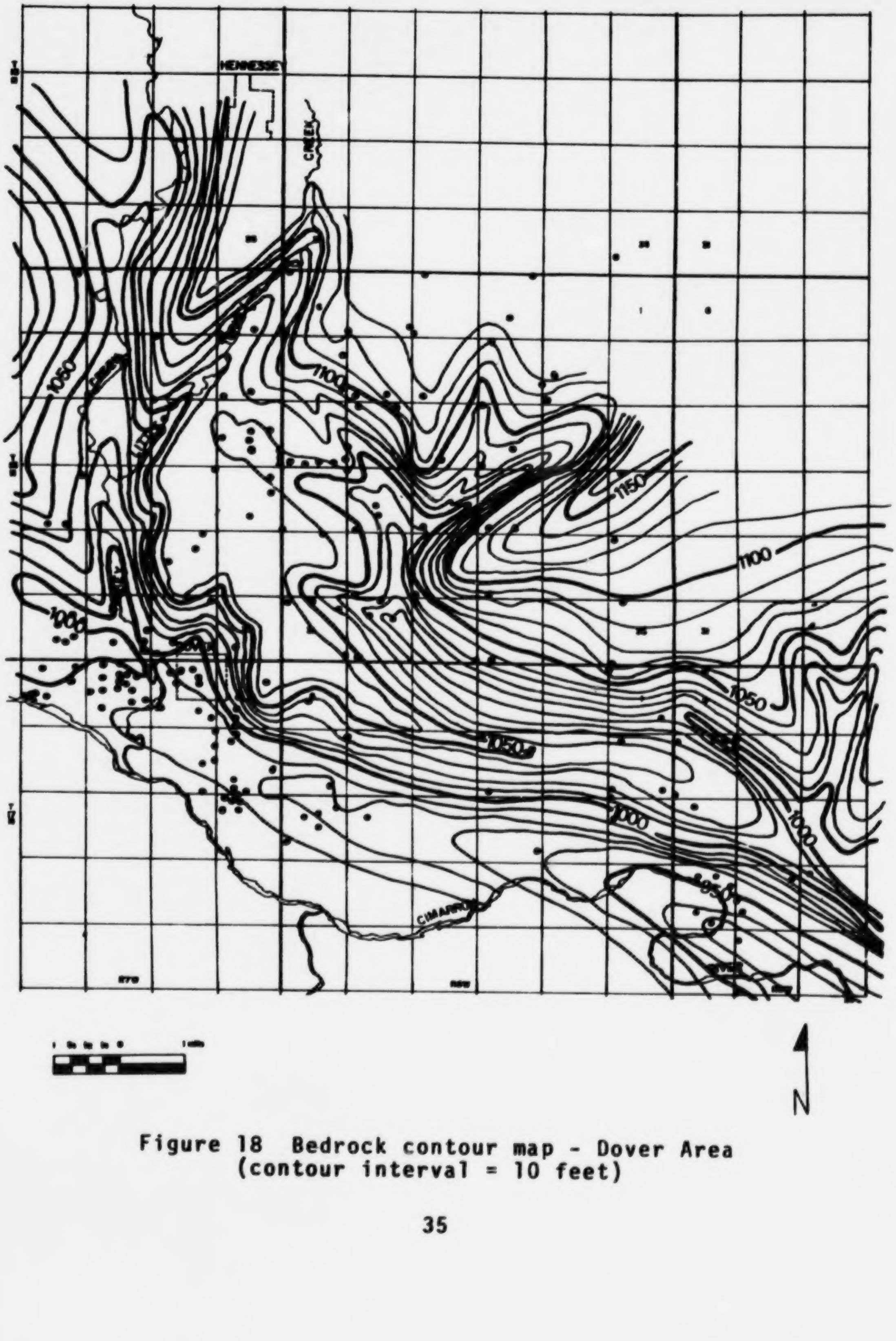
HENNESSEY
CREEK
1050
1100
1150
1100
1000
1050
1050
1000
1000
950
CIMARRON
RIVER
R7W
R6W
N

Figure 18 Bedrock contour map - Dover Area
(contour interval = 10 feet)

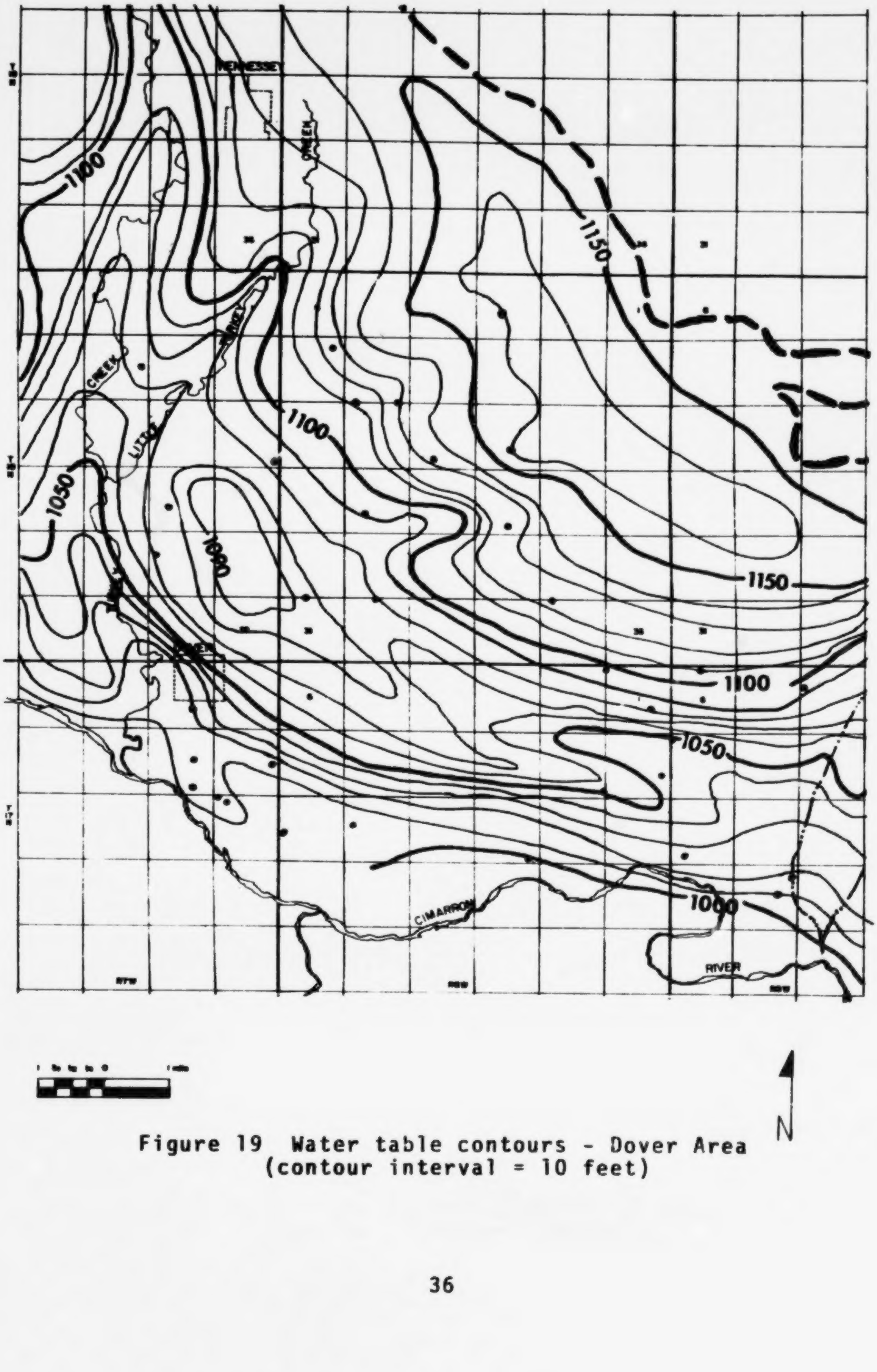
HENNESSEY
CREEK
1100
1150
TURKEY
CREEK
LITTLE
1100
1050
1000
TURKEY
DOVER
1150
1100
1050
CIMARRON
1000
RIVER
N

Figure 19 Water table contours - Dover Area
(contour interval = 10 feet)

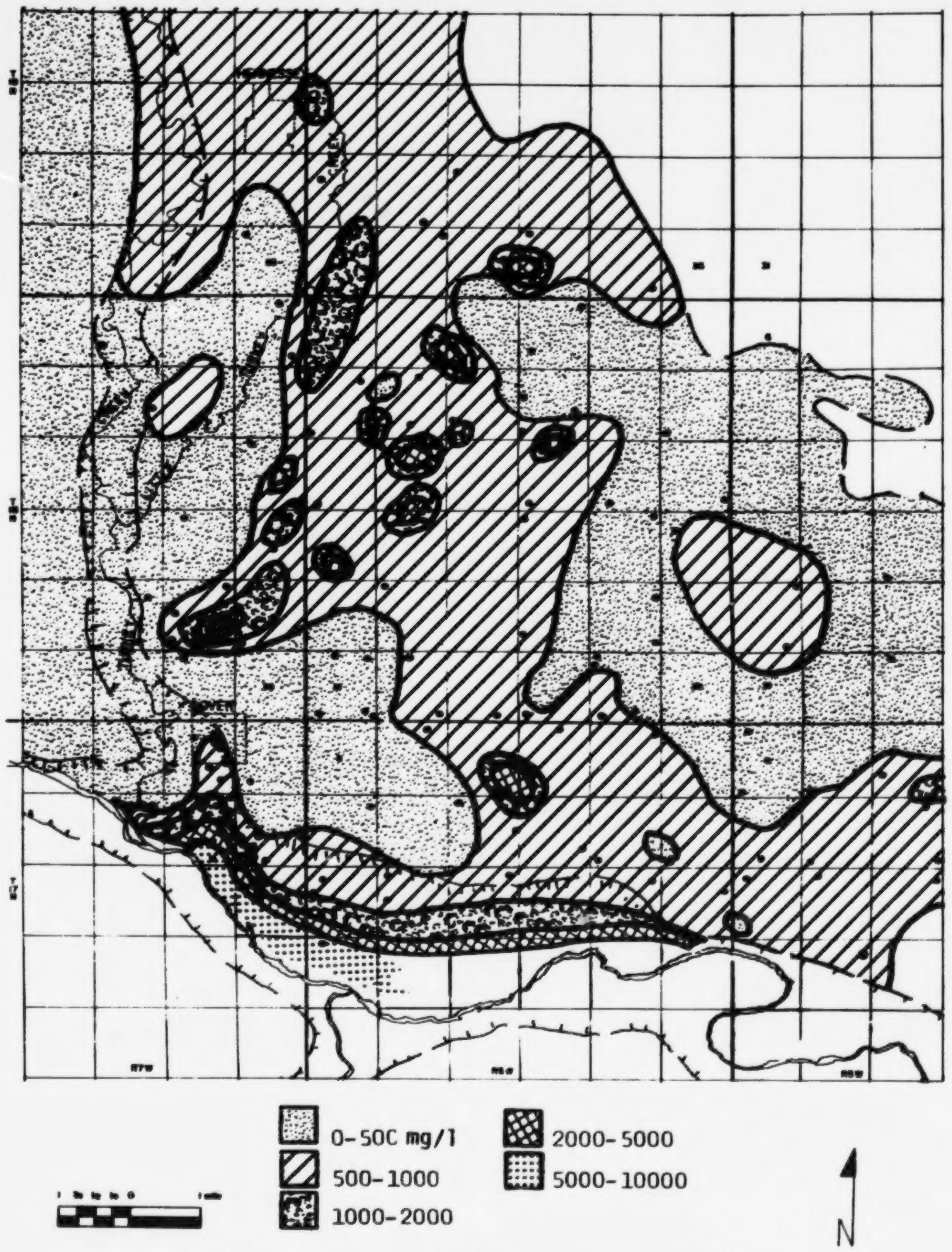
DOVER
0-50C mg/l
500-1000
1000-2000
2000-5000
5000-10000
N

Figure 20 Chlorides - Dover Area

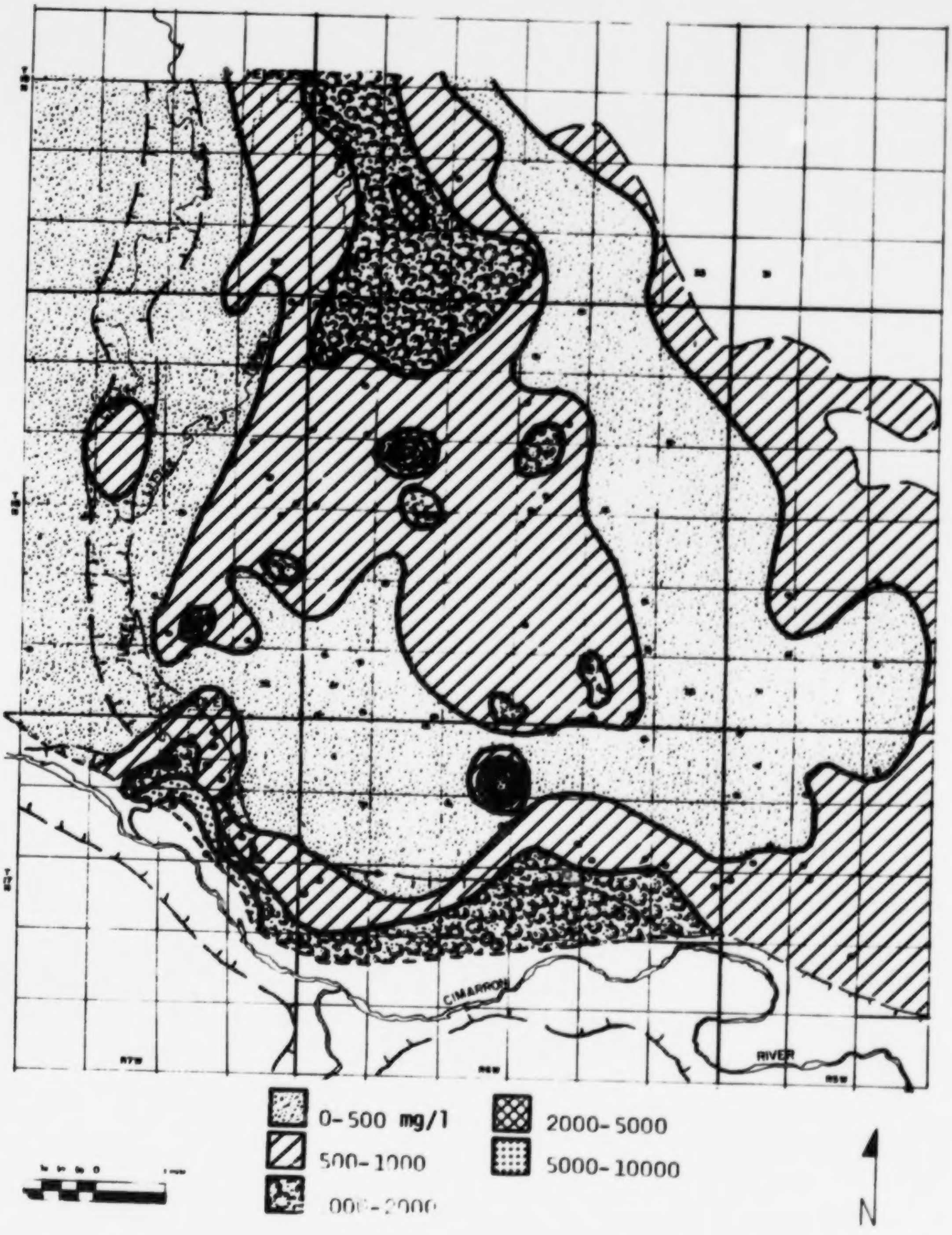
CIMARRON
RIVER
R7W
R6W
R5W
0-500 mg/l
500-1000
000-2000
2000-5000
5000-10000
N

Figure 21 Total dissolved solids - Dover Area

Two test holes were drilled in the buried alluvial valley in the southwest quarter of section 20 in the Dover-Hennessey area. A 140-foot well was completed in bedrock by cementing the casing to a depth of 66 feet sealing off the terrace water. A water sample obtained from the bedrock contained 1,074 ppm chlorides. A second well drilled nearby but screened near the bottom of the terrace sands at 65 feet, produced water containing only 143 ppm chlorides. Static water levels in the two wells were measured to be at the same elevation. If salt water from seepage pits had entered the terrace it should have been present in the bottom of the alluvial channel at the location of this test hole.

The above test well data and the sodium/chloride ratio (see page 37) establishes that the source of the salt water in the Dover-Hennessey area is from natural sources in the Permian redbed formations. Further, it may be predicted that if large withdrawals are made from the terrace lowering the hydrostatic head in that aquifer, salt water from the underlying redbeds may flow upward causing local increases in chlorides.

RESISTIVITY

It was found that the reliability of surface resistivity techniques is directly associated with the complexity of the geology. Figure 22 shows the locations of all resistivity stations in the Crescent area and apparent resistivities are tabulated in Appendix A, Table A-4.

At station 34-5, for example, the geology is very simple, consisting of a three layer system of dry sand, wet sand, and the redbeds. Figure 23 shows a comparison of the lithology, borehole resistivity, apparent resistivity, and Barnes layer

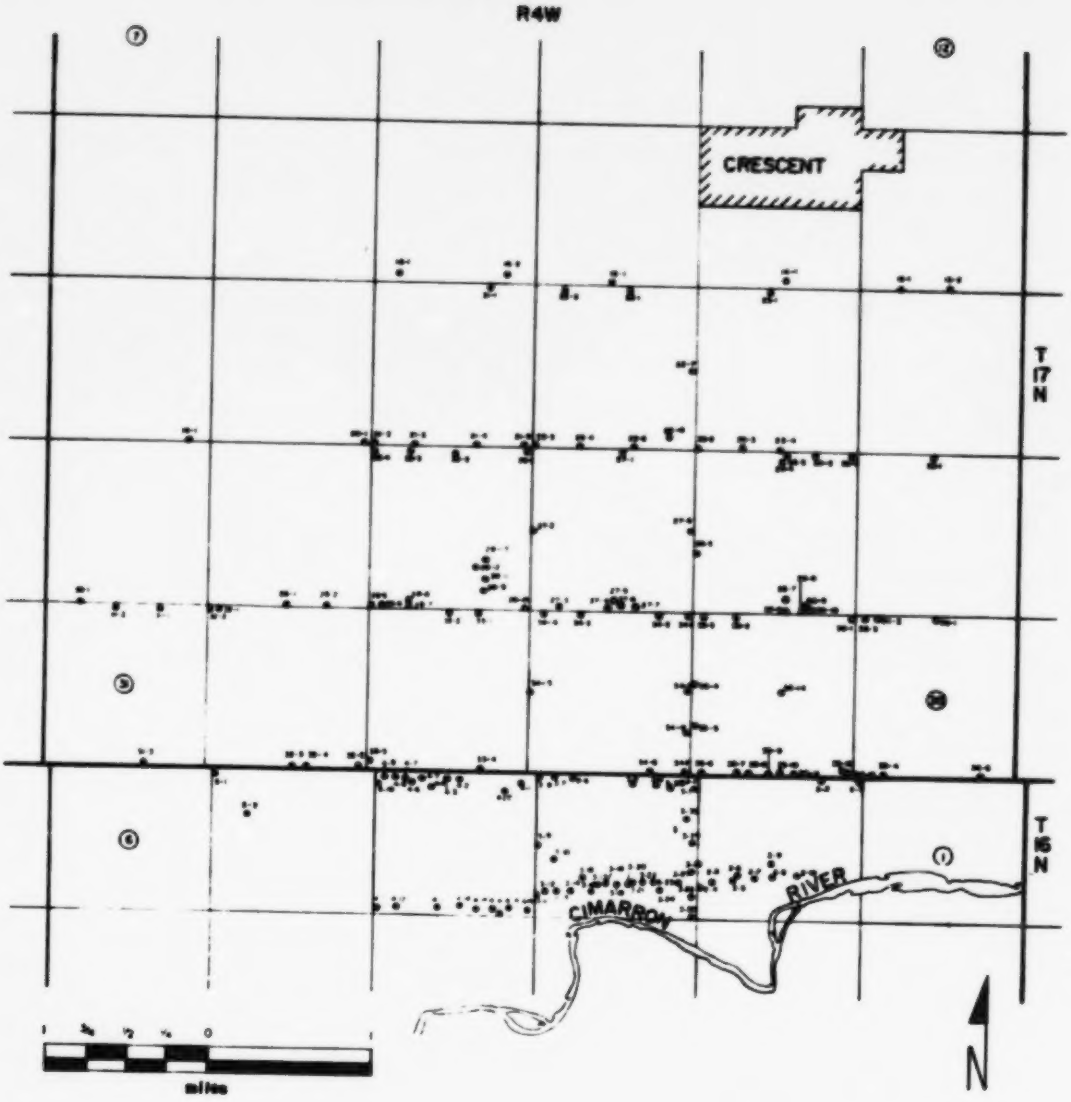
R4W
CRESCENT
T 17 N
T 16 N
CIMARRON
RIVER
N
1
3/4
1/2
1/4
0
1
miles
7
12
5
6
1

Figure 22 Locations of resistivity stations - Crescent Area

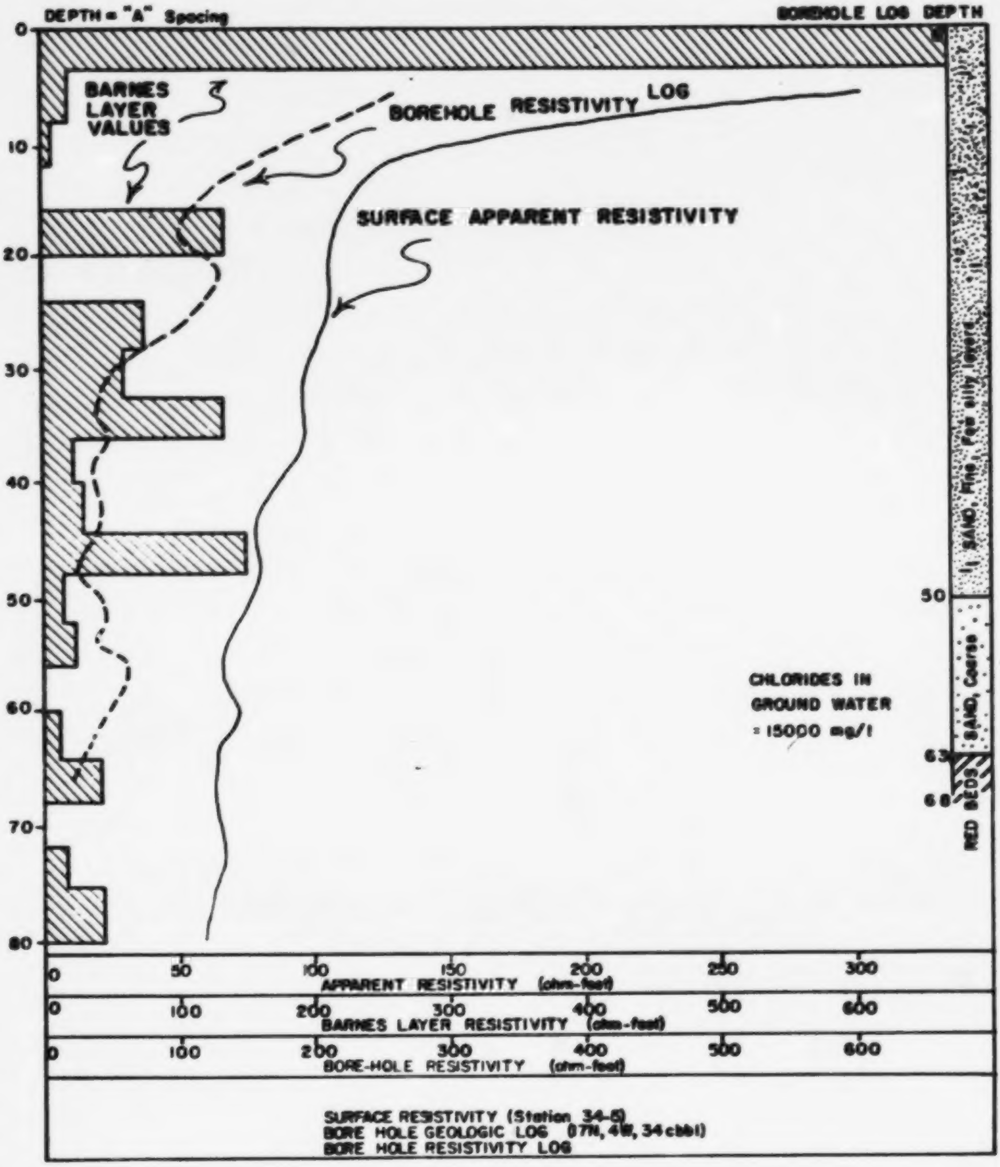

Figure 23 Plot of Station Data - 34-5

values. Specifically, the apparent resistivity of "A" spacing (depth) of 80 feet is low (about 60 ohm-feet), the borehole resistivity at a depth of the coarse sand is low (about 50 ohm-feet), and the Barnes layer values in the coarse sand are low (about 25 ohm-feet). These low values are to be expected because of the high chloride content of 15,000 mg/l.

Figure 24 shows resistivity results of station 21-2. It is comparable to Figure 23 except that Barnes layer values are not usable due to "backup", and the chloride concentration was only 51 mg/l. As expected, both the surface resistivity and borehole resistivity were higher than the previous example. Specifically, at a depth of 80 feet, the surface resistivity exceeds 300 ohm-feet, and the borehole resistivity reaches 480 ohm-feet within the coarse sand layer. The low chloride water results in significantly higher resistivity values when compared with Figure 23. It should be noted that surface resistivity very clearly shows the location of both the water table and the redbeds. As in the previous example, the geology of this location is relatively simple, consisting predominately of sand with only a thin silt layer present.

The two examples shown in Figure 23 and 24 demonstrate that surface resitivity does perform well in a geologically simple environment and gives the expected results according to the basic theory on which the method is founded.

A third example is shown in Figure 25, station 22-1, where the terrace is composed primarily of silt and clay. At this station, the apparent resistivity is about 50 ohm-feet, and the Barnes layer value just above bedrock is about 12 ohm-feet. In addition, the borehole resistivity is only about 50 ohm-feet, just above bedrock. The low values are about equivalent to the values shown in Figure 23 in a salty area,

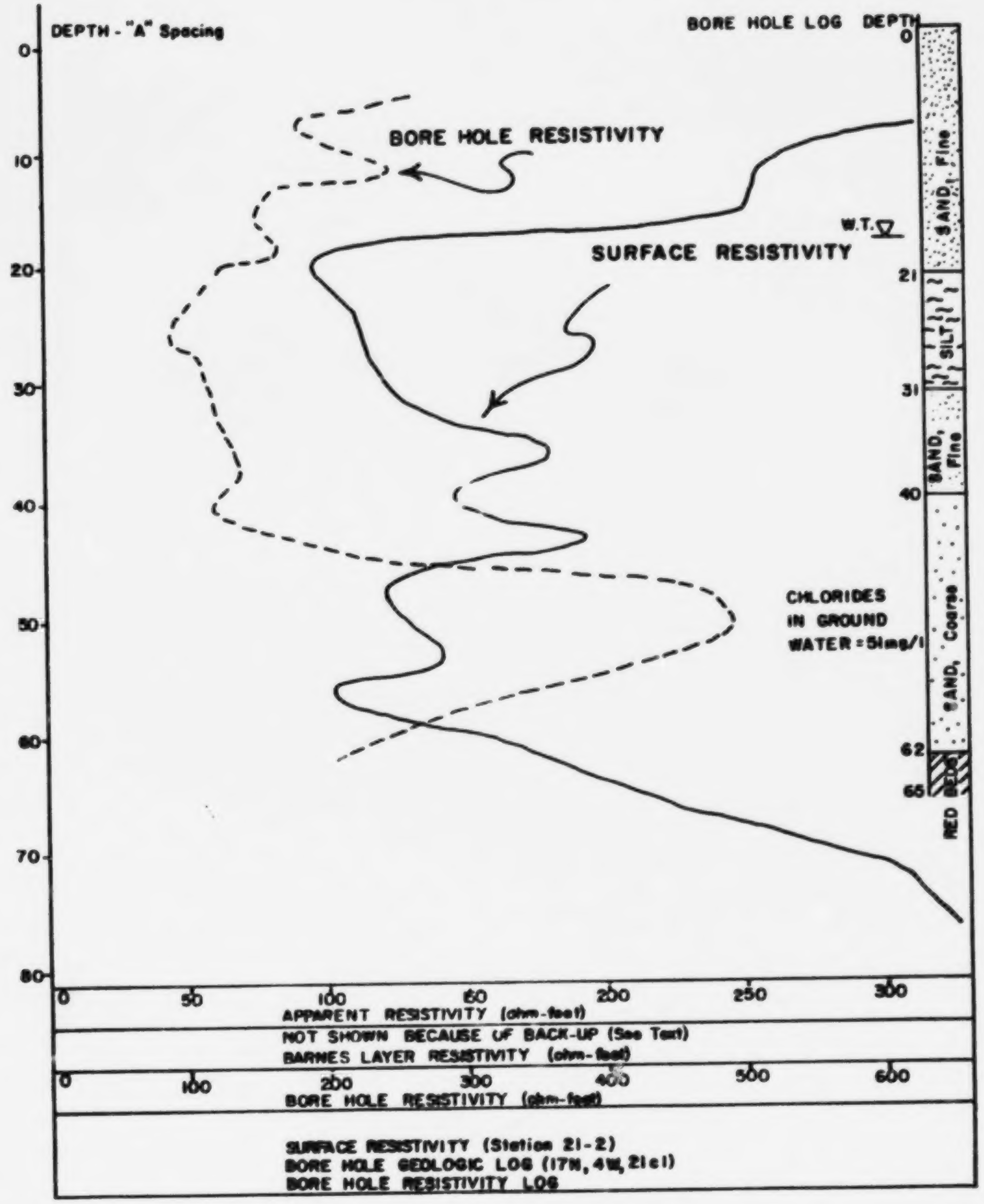

Figure 24 Plot of Station Data - 21-2

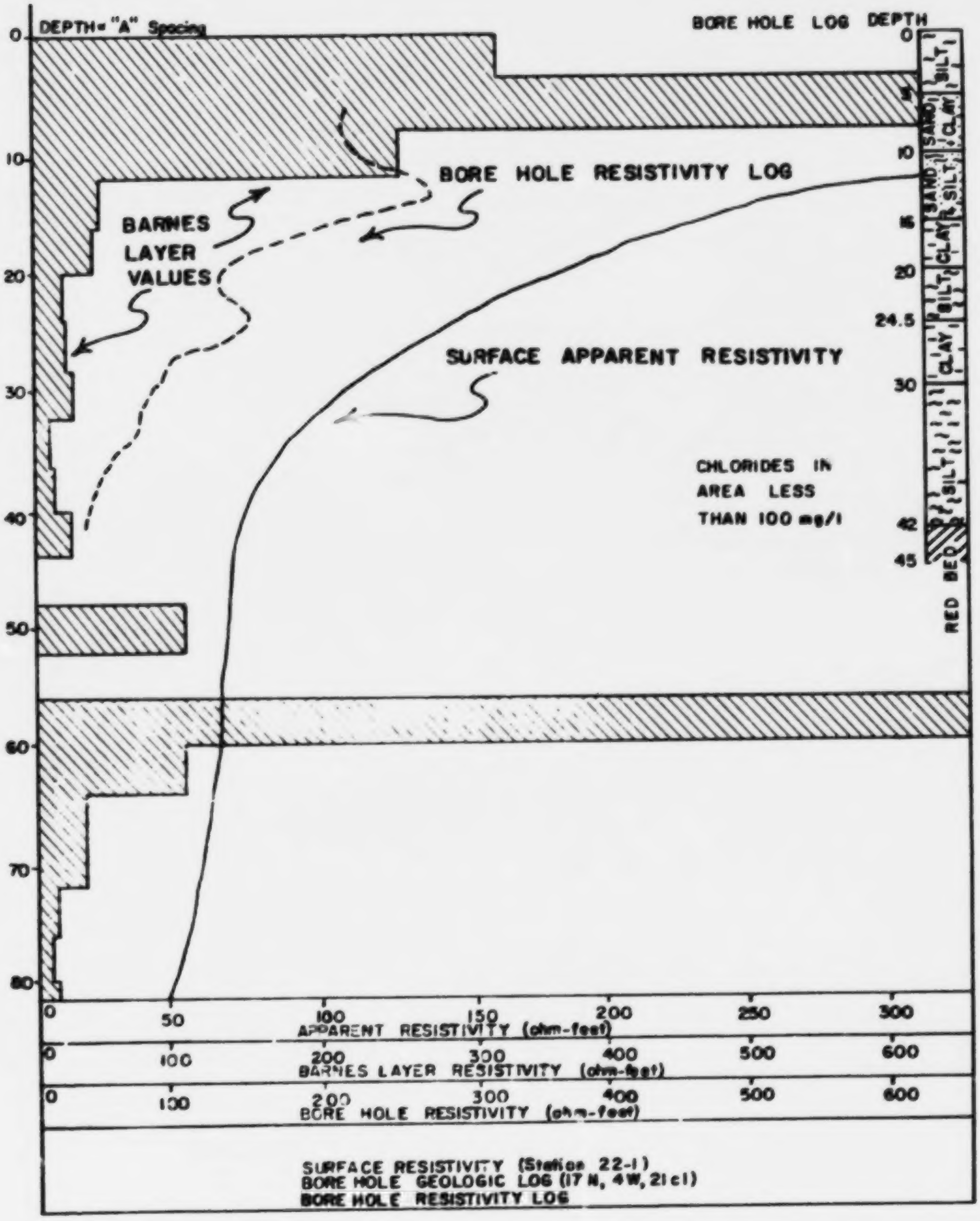

Figure 25 Plot of Station Data - 22-1

however, water quality in the vicinity of Figure 25 is low in chlorides. The low resistivity values are caused by the presence of silt and clay.

At other stations, it was noted that where a significantly thick clay layer was present above a fresh water sand, surface resistivity values were low. It is concluded that where significant clay layers are present in a sand aquifer, it is difficult to differentiate between the clay and the brackish water in the sand using surface resistivity.

Figure 26 is an interpretive map in the Crescent area on apparent resistivities at the 80-foot "A" spacings. Figure 27 is an interpretive map based on the Barnes layer values at the bottom of the terrace material just above bedrock. It should be noted that both of these maps show areas of very low resistivity in sections 34 and 27 comparable to the areas of high chlorides. Generally, the resistivity maps correlate well with water quality maps except that, in areas where the terrace deposits contain significant clay, the resistivity maps show moderately low values even though the water quality is good.

For example, the relatively low resistivity values shown on both the Barnes layer and apparent resistivity maps in the northern and northeastern part of the area reflect a thinning of the terrace and areas of predominately clay and silt deposition. Because of the clay and silt, low resistivities were recorded even though the water quality is good.

The Barnes layer interpretive method appears to present a slightly more accurate reflection of salt content than does the apparent resistivity map. The moderately high chlorides in the southeast corner of section 30, in the southeast

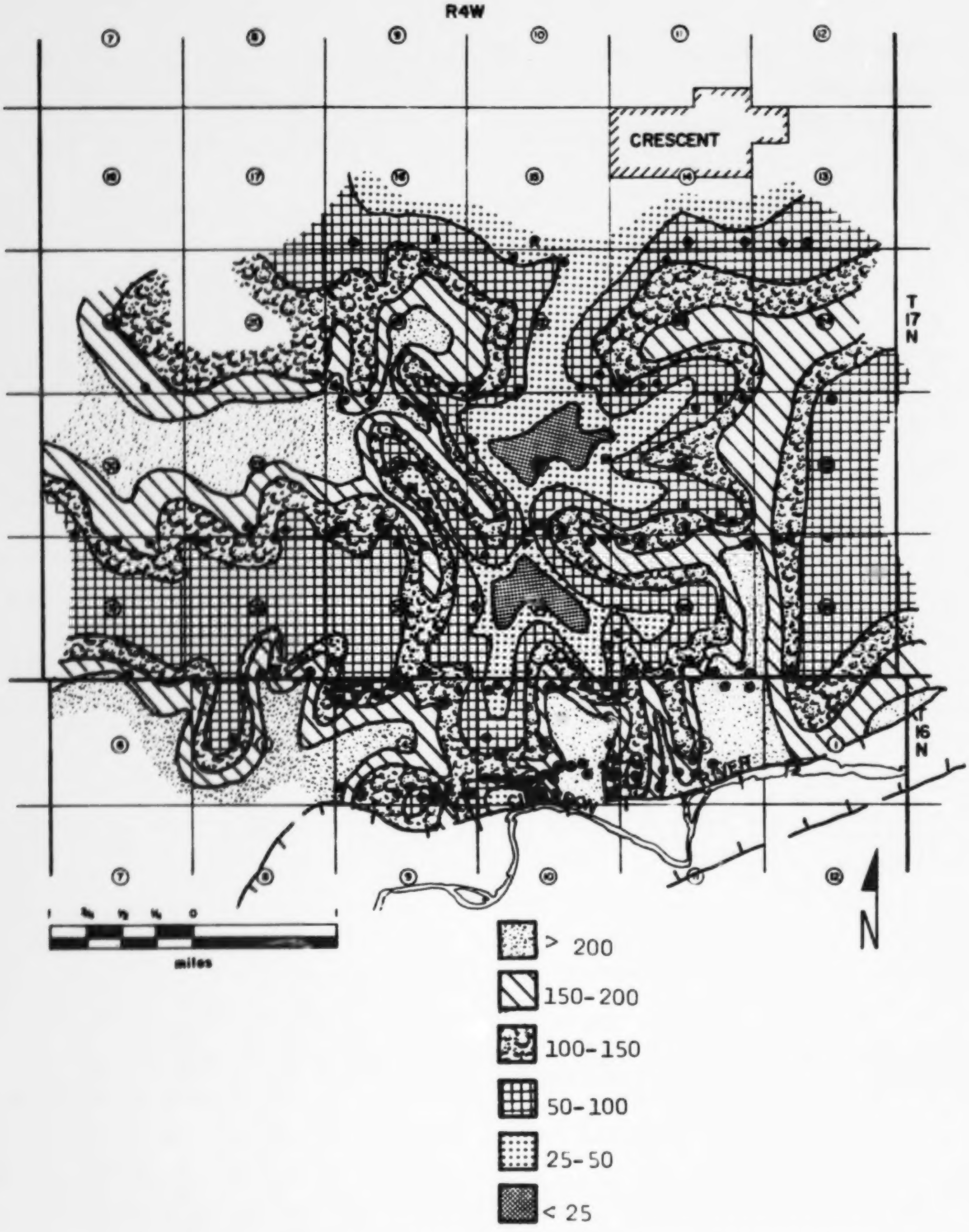
R4W
7
8
9
10
11
12
CRESCENT
18
17
16
15
14
13
T 17 N
T 16 N
miles
N
> 200
150-200
100-150
50-100
25-50
< 25

Figure 26 Surface resistivity - apparent resistivity at 80 feet - Crescent Area

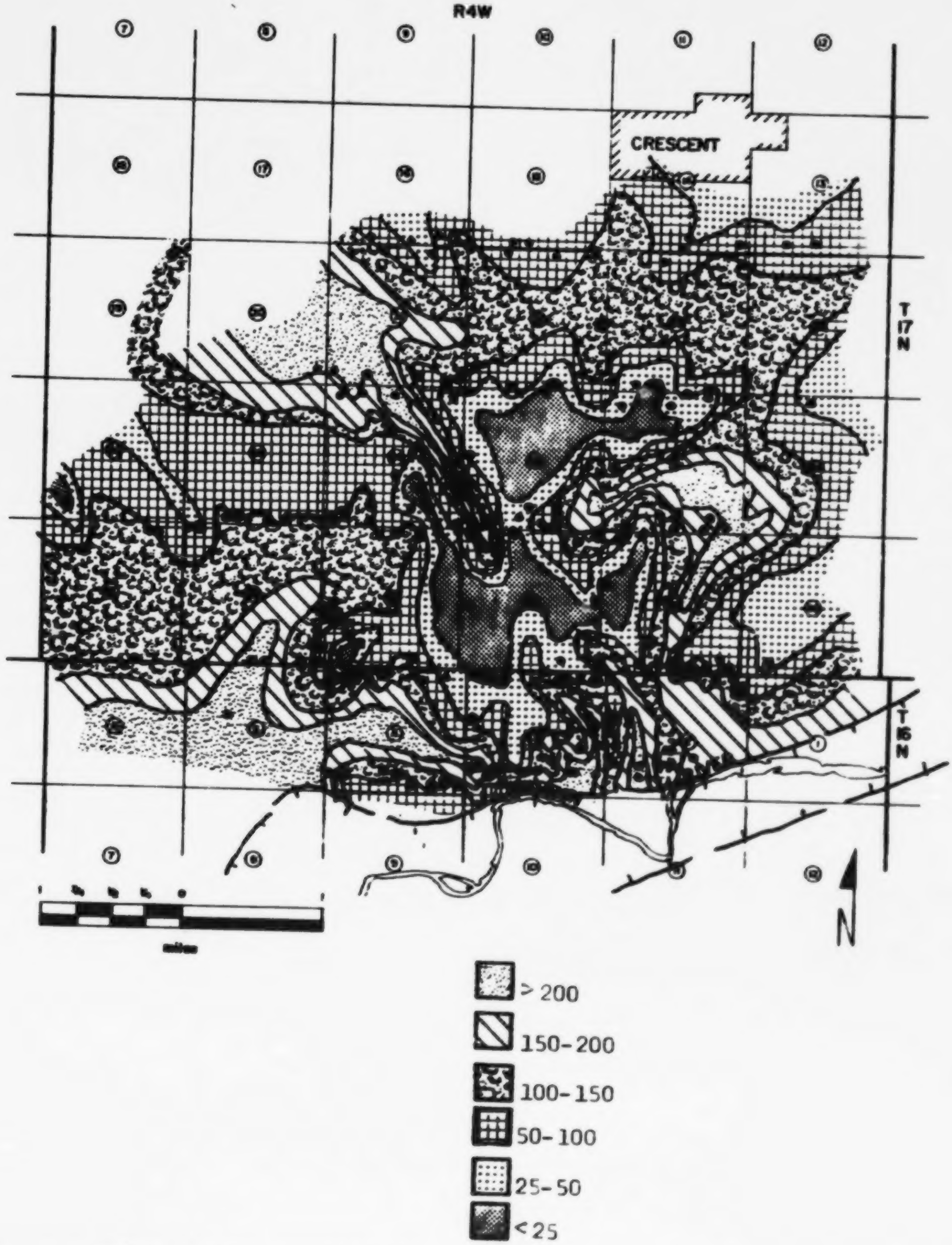
R4W
CRESCENT
T 17 N
T 16 N
miles
> 200
150-200
100-150
50-100
25-50
< 25

Figure 27 Surface resistivity - Barnes Layer - Crescent Area

corner of section 33, and in the western part of section 35 were reflected by the Barnes layer resistivity values, whereas the apparent resistivity interpretive map does not show those details.

It should also be noted that the southeasterly trending good quality water feature in sections 28 and 34 observable on all three water quality maps is also observable on both of the resistivity interpretive maps. This indentation into the contaminated zone is caused by fresh water flowing southeastward from section 28 into section 34 down the buried channel shown on Figure 10.

In conclusion, surface resistivity has been demonstrated to effectively delineate areas of salt water contamination in areas where lateral changes in surface resistivity values are caused by lateral changes in water salinity. However, where other subsurface conditions exist, such as variation in clay content which also affect the resistivity values, the effectiveness of surface resistivity is decreased. Surface resistivity should be effective for delineating salt water contamination in most geologic environments where lateral changes other than salt concentration in the subsurface are minimal.

SODIUM/CHLORIDE RATIO

According to Leonard[22] a sodium/chloride ratio above 0.6 is considered typical of natural brines emerging from halite beds found in the Flowerpot formation whereas ratios below 0.5 are considered typical of oil field brines.

Analyses of brines discharged into disposal pits (Table A-3) averages about 150,000 mg/l chloride whereas the highest concentration found in terrace groundwater (near Crescent) is 15,000 mg/l. These oil field brines have a sodium/chloride ratio of 0.37, and the contaminated groundwater has a ratio of 0.38. Natural salt water springs at the northwest end of the terrace have a sodium/chloride ratio of 0.62. The fact that salt water in the terrace has a sodium/chloride ratio nearly identical with that of the oil field brines greatly supports the argument that the source of the water is via the disposal pits.

Examination of the chemical analyses of samples containing over 250 ppm chlorides in the Dover-Hennessey area shows that sodium/chloride ratios are mostly about 0.66 (several anomalous ratios of 0.1 or less may be due to lab error). Only a few have ratios in the 0.3 range common in the oil field brines in this area. The brine fingerprinting evidence and the fact that high chlorides are found mainly in wells completed into bedrock suggest that the source of the chlorides is from the Permian redbeds.

AQUIFER RESTORATION

A large abandoned "evaporation" pit is located in the southeast corner of section 28, near Crescent, in an area underlain by moderately salty water, and other pits are believed to have been located in the southern part of section 22. However, water with the highest salt concentration lies to the south and southeast in the general direction of flow. The following estimate is made of the rate at which the salt water is moving toward the Cimarron River.

$$v = \frac{PI}{7.48\ E}$$

where v = velocity in feet per day

P = permeability of terrace, estimated to be 400 gpd/ft^2

I = hydraulic gradient = 6×10^{-3} (Figure 12)

E = porosity of terrace sand, estimated to be 0.3

$$v = \frac{(400)\ (0.006)}{(7.48)\ (0.3)} = 1 \text{ foot per day or 365 feet per year}$$

The pit was used between about 1930 and 1950, therefore, after allowing 5 years for the salt to percolate downward into the aquifer, the main body of salt water should be between about 7,000 and 14,000 feet to the southeast of the pit in the direction of groundwater flow as shown on Figure 12. However, the chloride map (Figure 13) shows that the main body of salty water is located only 4,000 to 6,000 feet southeast from the abandoned pit.

It is apparent from the foregoing discussions that the concentrated brine discharged into the evaporation pits has been continuously diluted by the natural groundwater flow through the terrace. The residual high chlorides are continuing to be flushed out of the terrace and into the Cimarron River, however, the rate of flushing is apparently about one-half the estimated rate of flow of the groundwater. Assuming that future groundwater withdrawals do not significantly change the groundwater gradient, it may be estimated that approximately 100 additional years will be required for the salt water to be flushed out of the terrace aquifer south of Crescent.

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APPENDIX A

Explanatory page about well numbering system

Table A-1 Water Well Data

Table A-2 Water Quality Data

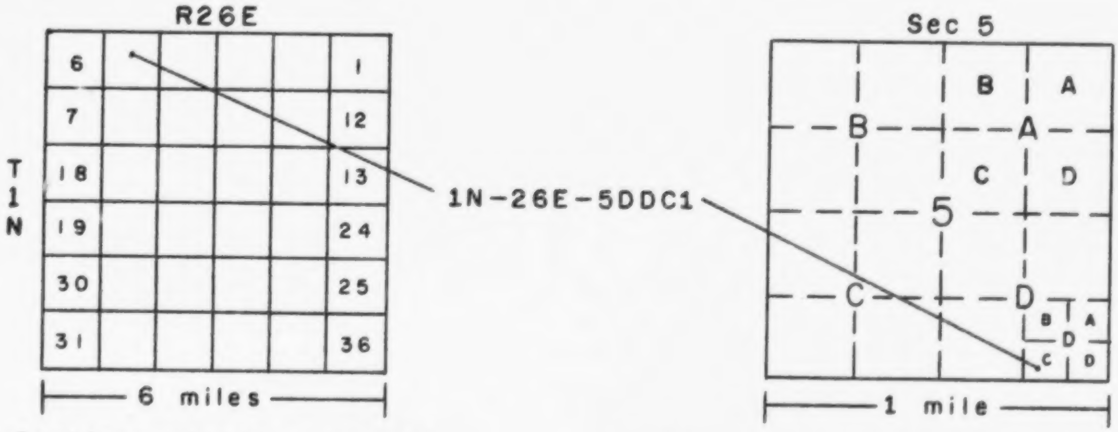
Table A-3 Water Quality Data - Oil Field Brines

Table A-4 Resistivity Stations

Table A-5 Lithologic Logs

WELL NUMBERING SYSTEM

The well numbering system used in the following tables is based on the Bureau of Land Management system of land subdivision. In the location system the first digit of a well number indicates the township, the second the range, and the third the section in which the well is located. The first uppercase letter denotes the quarter section (160-acre tract), the second the quarter-quarter section (40-acre tract), and the third the quarter-quarter-quarter section (10-acre tract). Within each 10-acre tract the wells are numbered serially as indicated by the final digit of the number. Thus, in Beaver County, the number 1N26E-5DDC1 indicates that the well is in the SW¼SE¼SE¼ Section 5, Township 1N, Range 26ECM as shown below:



Sections within a township

Subdivisions within a section

Figure 28 Diagram showing well-numbering system used in Oklahoma

Table A-1 WATER WELL DATA

Table A-1. WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness		Water Level		Elevations[2]			Other Data[3]
					Total (ft)	Saturated (ft)	Date	Depth (ft)	S	WT	BR	
TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN												
1acc	D		30						970		940	S
1adb	D		37						960		923	
2aaa	S	9	62				10-24-72	34.5	1020	985	958	S
2aba	O	8	95		70		8-16-72	71.09	1060	989	990	S
2acc	D		90	1963					1005			S
2bab	D		65									S
2bbd1	O	1¼	45	1973	45	24	5-30-73	25.53	1012	986	967	L,S
2bbb2	D	6	56	1968			10-24-72	29.90	1010	980	954	S
2bbb1	D	6	43				8-5-73	23.2	992	979	949	S
2cac	O			1973	16				998		982	
3aab	D	7	36	1972	30				995		959	S
3aab	O	4½	41	1973			6-12-73	24.70	1011	986	975	L,S
3cbb		6	67				6-18-71	36.11	1027	991	960	
3bbd	O			1972	69	40			1030		961	L
3bbb	O			1973	60				1030		970	L
3bcc	O			1972	51				1027		976	L
3cdc	O			1972	37				1013		976	L
3dac	O	4		1972	17				1005		988	L
4abb2	A		57				8-3-71	53.50	1048		991	
4aba	S		50	1954			8-10-71	25.4	1030	1005	980	
4aac	O			1972	48				1032		984	L,S
4baa	O	1¼	55	1972	60	60	3-14-73	43.21	1048	1005	988	L,S
4bbc	D				40				1000		960	
4ddc	O			1972	42				1020		978	L
5bbb	S						10-25-72	30.	1036	1006		

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.

(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.

(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN												
5cbc	D		32	1958			12-18-72	20.75	1015	994	983	
5cca	Ir		25		25				1009		984	
5cab	Ir	12 3/4	80	1972	80				1010		930	
6baa	D		55						1035		980	
6cbb	D		55	1961			4-28-71	26.	1020	994	965	
6aac					38				1000		988	
7ddd	M		80						960		880	
7dca			40					30.	960	930	920	
8bbd	Ir	12 3/4	84	1971	84				1005		921	
TOWNSHIP 16 NORTH, RANGE 5 WEST INDIAN MERIDIAN												
3bba	Ir		28	1966	27	20			975		948	S
3dcc1	Ir		28	1966	28	21			970		942	S
3dcc2	Ir	6	28	1964	28							
12cdb	Ir	6	35	1967	34		5-3-67	9.	970	961	936	
TOWNSHIP 17 NORTH, RANGE 3 WEST INDIAN MERIDIAN												
18cbd	D	42	41	1889			11-15-72	20.	1110	1090	1069	S
18dca	D		190	1942								S
19aab	D		175	1937								S
19abb	D		130	1945								
30ccc	D		30				12-4-72	21.01	1040	1019	1010	S
31bbb	S											S

[1] D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.

[2] Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.

[3] L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN												
2bbb	D		35						1015		980	
3bcc	D		25					24.	1110	1086	1085	
3ddd	D		31					20.	1130	1110	1099	
6ccc	O			1973	47				1162		1115	L
10ddd	D											S
13dcc	S		35						1103		1068	
14ddd	O			1973	31				1100		1069	L
14dcc	O			1973	43				1116		1073	L
15bdd	D		60	1957				30.	1171	1141	1111	S
15ddd	D		50	1957					1140		1090	S
15cdc	O	7	50	1972	50				1130		1080	L
16daa	D		70	1943			12-7-72	18.20	1133	1115	1073	S
16ddd	O			1973	32				1109		1077	L
16dcc	O			1973	65				1115		1050	L
17daa	D		135	1938			12-14-72	22.	1120	1098		S
17dcd	S											S
17cdd	S		90						1090		1000	
18ddd	D		108	1954				30.	1093	1063	985	S
18ccc			90					75.	1080	1005	990	
19aad	O			1974	88				1090		1002	L
19add	O			1974	81				1080		999	L
19dad	O			1974	76				1077		1001	L
19dcc	O			1974	76				1073		997	L
20aba	S		65	1968	65				1090		1025	S
20ada					65				1090		1025	S
20ccb	D				60				1078		1018	S

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness		Water Level		Elevations[2]			Other Data[3]
					Total (ft)	Saturated (ft)	Date	Depth (ft)	S	WT	BR	
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN												
20bdb	Ir				92				1090		998	
21aaa	D		70						1110		1040	S
21bbc	S											S
21ccc1	A		63	1922			12-21-72	27.	1053	1026	990	
21ccc2	M	12	68	1962	68				1046		978	S
21cdc	M	12	90	1962	90				1058		968	S
21cdd	M	12	85	1962	85				1067		982	S
21dcc	S		100	1955			12-21-72	39.80	1067	1027	967	S
21daa	S		90				12-21-72	40.00	1082	1042	992	S
21ccc	O			1973	62				1051		989	L
21cbb	O			1973	89				1080		991	L
22aaa1	D	8	68	1951			5-17-72	30.64	1140	1109	1072	S
22aab	D		55	1955					1140		1085	S
22aba	D		60	1960					1150		1090	S
22bab	S		50	1966			12-7-72	13.	1150	1137	1100	S
22aaa2	O			1973	42				1131		1095	L
22daa	O			1973	71				1130		1059	L
23daa	D		130	1966				20.	1065	1045		S
23dcc	D,S	6	175	1951				75.	1080	1005		S
23ccc	O			1973	61				1112		1051	L
24bba	S	5½	65	1969					1090		1025	S
24ada	S		90	1891								S
24ddc	D,S								1060			S
25bba	D		16									S
25baa	O			1973	26				1083		1057	L
26aaa	O			1973	20				1055		1035	L

[1] D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
[2] Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
[3] L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness		Water Level		Elevations[2]			Other Data[3]
					Total (ft)	Saturated (ft)	Date	Depth (ft)	S	WT	BR	
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN												
26abb	O			1973	22				1078		1056	L
26dcd	O	7	27	1972	27				1015		988	L,S
26cdd	Ir	12	53				10-24-72	16.70	1027	1010	974	
26cdc	D		80	1937			11-8-72	45.	1045	1000	965	
26dcc	D											S
27abb	O			1973	40				1100		1060	L
27baa	S											S
27bba	D											S
27add	O			1973	45				1060		1015	L
27cbb1	O	4½		1973	44		4-23-73	10.42	1036	1026	992	L,S
27dcc	O	7		1972	58				1050		992	L,S
27cdc	O	4½	34	1973	33		4-23-73	11.34	1024	1013	991	L,S
27aba	S		45	1955			5-17-72	26.60	1095	1068	1050	S
27dda	D								1047			S
28aaa	O			1973	60				1060		1000	L
28abb	O			1973	77				1068		991	L
28ccc	O			1973	58				1048		990	L
28cdd	O			1973	40				1032		992	L
28ddb	O	7	63	1972	63		9-21-72	38.90	1057	1020	994	L,S
28cdc	Ir								1052			S
29daa	O			1973	67				1062		995	L
29ccb	D,S		60						1063		1003	S
29cac	Ir						11-10-72	20.6	1062	1041		
29dcb	Ir		68						1066		998	S
29dda1	D		64	1967					1050		986	S
29dca	D		50				11-10-72	29.5	1060	1030	1010	

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface, WT = Water Table, BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN												
29dda2	A		25				11-9-72	15.80	1050	1034		
29bcc	O			1974	64				1063		998	L
30ddd	S											S
31bba	Ir	12			81		11-16-72	26.16	1061	1035	980	
31cdd	D,S	5½	50	1952			12-18-72	29.20	1040	1011	990	S
31bad	S		78				11-15-72	31.0	1061	1030	983	S
31ccc	O	4½	53	1972	50		11-20-73	23.61	1045	1021	995	L,S
31add	O			1974	74				1056		981	L
31aba	O			1974	64				1059		995	L
32bbb1	O			1973	70				1061		991	L
32dcc	O			1973	67				1050		986	L
32bbb2	S		60	1967					1063		1003	S
32bba	A		60	1952			11-16-72	31.10	1063	1032	1003	S
32cdc			58						1030		972	S
32aad	S											S
32dad	A		69				10-24-72	48.55	1061	1012	992	
33dbb	O			1974	77				1069		983	L
33aab	O	1¼	64	1973	65	30	4-28-73	35.04	1058	1023	993	L,S
33cbb	O			1973	77				1054		977	L
33ccc	O			1973	56				1050		994	L
33abb	D		60	1970					1050		990	S
33bbb	D		75						1050		975	S
33bba	A		32	1938			11-8-72	10.80	1046	1035		S
33bdb	In		50	1967					1035		985	S
33cca	A	2	28				10-25-72	3.10	1010	1007	982	
33ccd	O			1974	33				1000		967	L

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN												
33dda	O	4½	82	1974	80				1045		965	L,S
34aaa	O			1973	66				1048		982	L
34aab	O	1½	75	1973	74	43	4-23-73	30.55	1058	1027	984	L,S
34abb	O	4½	54	1973	56	22	4-23-73	33.85	1045	1011	989	L,S
34bab	O	1¼	43	1973	43	39	4-23-73	4.27	1023	1019	980	L,S
34bdd	O			1974	33				1010		977	L
34bbb	O	1¼	63	1973	62	31	4-23-73	30.96	1052	1021	990	L,S
34add	O			1973	56				1030		974	L
34cbb	O			1973	63				1050		987	L
34[illegible]cb	O	2	69	1973	71	19	4-23-73	52.46	1050	998	979	L,S
34cdc	O	4½	55	1973	54	26	4-23-73	28.24	1028	1000	974	L,S
34dcc	O	1¼	22	1973	20		3-13-73	5.79	990	984	970	L,S
34dad	A		40				10-24-72	23.90	1020	996	980	S
34cdd	A		32				10-25-72	24.60	1025	1000	993	
35cdc	O			1973	21				1000		979	L
35dcd	O			1973	73				1040		967	L
35bbb	Ir		45				12-13-73	37.8	1045	1007	1000	S
35ddd	D		75						1042		967	
35ddc	D		90					70.	1040	970	950	S
35aaa	D		105						1045			S
35aab	S		24				10-24-72	14.0	1013	999	989	S
35baa	Ir											S
35dcc	D		102	1971								S
36bba	O			1973	25				1051		1026	L
36cdc	O			1973	46				1018		972	L
36dcd	S		28	1920			10-24-72	32.60	1005	962	977	S

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN												
36cca	S								1025			S
36abb	S		50				10-24-72	71.00	1060	1023	1010	S
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN												
4cbb	S											S
4caa	D		70						1120		1050	
4bbb	O	4½	95.5	1973	95		11-9-73	26.25	1127	1101	1032	L,S
5ccc	D											S
6bba	O	4½	66		67		11-9-73	33.80	1146	1112	1079	L,S
6bdd	Ir	5½	77	1964	77		10-19-73	11.60	1112	1100	1055	
6ccc	D											S
7cdd	D	8	105	1960					1108		1003	S
7dbb	Ir	10	46	1966	42	29	8-12-66	13	1070	1057	1028	S
8ddd	O			1973	70				1089		1019	L
8ccc	S											S
9ddd	D											S
10dcc	O	4½	48.5	1973	45		11-9-73	21.10	1060	1039	1015	L,S
12aaa	D		95	1971			1971	45	1163		1068	
13dda	D		93	1961					1089		996	S
13ddd	O	4½	94	1973	89		11-9-73	34.72	1090	1055	1001	L,S
14dda	S		96	1957			12-13-72	29.40	1077		981	S
14cbc	O	4½	62	1973	61		11-9-73	20.94	1070	1049	1009	L,S
16aaa	D											S
17bba	D											S
18bba	S	6	80						1115		1035	S

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(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN												
18ccc	O	4½	33	1973	28		11-9-73	27.48	1050	1023	1012	L,S
19cdd	In	7	37	1968	35		6-28-68	7	984		949	
19cbd	In	7	39	1968	37		6-28-68	7	985		948	
19daa	In	12	35	1966	33		2-19-66	8	988		955	
19acb	In	8 5/8	30	1965	30		9-20-65	11	988		958	
19abc	In	8 5/8	31	1965	30		6-8-65	11	990		960	
19adb	In	12	25	1966	23		2-17-66	8	989		966	
19bad	In	8 5/8	34	1965	33		10-12-65	25	990		957	
19abb	In	8 5/8	25	1965	25		6-4-65	6	1020			
19cdd	In	7	35	1969	35		7-29-69	7	985		950	
20aaa	O			1973	25				1026		1001	L
20aab	O	4½	42	1973	39		11-9-73	29.28	1050	1021	1011	L,S
24abb	D		73						1082		1009	S
24bbc	D		90	1950					1078		988	S
25ccc	D		60	1946					1050		990	S
25dcd	D,S		78						1060		982	S
26aaa	S		70						1075		1005	S
26ccc	D											S
27aaa	O			1973	43				1055		1011	L
27ddd	O	4½	28	1973	24		11-9-73	7.67	1028	1020	1004	L,S
30ddb	M		45	1961					985		940	S
30aaa	Ir	7	27	1964	53		2-18-64	38.	979		926	
32acc	Ir		45						983		935	
32bbd	Ir	6	37	1967	37	26	4-26-67	38.	988		951	S
35ada	D		51	1940					1043		992	S
35aaa	D		65	1962					1043		978	S

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[3] L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN												
35bab	D		40	1932					1044		1004	S
36bbc	D		65	1950					1050		985	S
36aba	Ir	12	89	1973	85		11-15-73	29.25	1055		970	
TOWNSHIP 17 NORTH, RANGE 6 WEST INDIAN MERIDIAN												
1dbd	Ir	12 3/4	82	1970	80	40	7-23-70	33.2	1103	1070	1023	
2aaa1	D,S	6	102	1972			8- -72	40				S
2aaa2	O	4½	42	1973	47	21	6-6-73	25.50	1120	1094	1073	L,S
2acc		Ir							1103			
3abb	S											S
4dcd	D,S											S
5aba	D,S	6	60	1950				30.				S
6caa	Ir	16	44	1953	44			17.	1080		1036	
7aaa	O			1973	34				1080		1046	L
7aad	S											S
7dcb	Ir	12	40	1946	40	33	10-1-64	7.	1020	1113	980	
9aaa	O			1973	63				1089		1026	L
9add	S											S
9bbb	S											S
10aaa	Ir	12	50	1952	50	26	2-24-53	24.	1080	1056	1030	
10ccb	O			1973	17				1140		1123	L
10dad	S											S
11ddd1	O			1973	44				1070		1026	L
11ddd2	O	4½	59	1973	57	20	6-6-73	36.97	1080	1053	1023	L,S
11ccc	D											S

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(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness		Water Level		Elevations[2]			Other Data[3]
					Total (ft)	Saturated (ft)	Date	Depth (ft)	S	WT	BR	
TOWNSHIP 17 NORTH, RANGE 6 WEST INDIAN MERIDIAN												
12aaa	O	4½	75	1973	77	33	6-7-73	43.50	1095	1051	1018	L,S
12bbb	O			1973	83				1097		1014	L
12dda	In	5½	100				5-16-73	46.40				
12dac	Ir	12 3/4	63	1971	62	29	2-23-71	33.	1100	1067	1038	
12ccc	S											S
14aad	D	6	22		22				1040		1018	S
15ddb	Ir	6	33	1972	33		4-4-73	0.00	1000		967	S
16aaa	D		50									S
16bab	D		47				4-30-71	14.				
17bcd	Ir	6	35	1972	35		7-20-72	4.	1010		975	
17bbb	S	1½	22									S
17bbd	Ir	2	40	1948			2-24-53	15.				
17bcc	S											S
17cac	Ir	2		1953			8- -54	12.				
18cac	Ir	1¼	35	1940	35		2-23-53	10.	1016		981	
18bba	Ir	2	35	1947	35		2-23-53	10.	1015		980	S
18bdc	Ir	2	35	1941	35		2-23-53	10.	1014		979	
18aab	Ir	2	38	1946			2-24-53	15.	1020		982	
18aac	Ir	12	40				10-1-64	9.	1020		980	
18add	Ir	12	35	1954			10-1-64	4.				
18bcc	O	4½	30	1973	28	24	6-6-73	4.17	1013	1009	985	L,S
19bbb	D,S											S

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(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness		Water Level		Elevations[2]			Other Data[3]
					Total (ft)	Saturated (ft)	Date	Depth (ft)	S	WT	BR	
TOWNSHIP 17 NORTH, RANGE 7 WEST INDIAN MERIDIAN												
1aca	Ir	12 3/4	38	1971	36		9-21-71	12.	1075		1069	
1bcc	Ir	2	28	1949			2-26-53	9.	1040		1012	
2dbd	O	4½	41.5	1973	35	26	6- 6-73	9.40	1023	1014	988	L,S
2aca2	M	8	32	1970	38	26	4-20-70	12.	1030		992	S
2abd1	M	8	32	1970	38	26	4-20-70	12.	1032		994	S
2ddb	Ir		35	1947	35		4-23-53	8.	1023		988	S
2dbc	Ir		40	1947	40		4-23-53	10.	1024		984	
2daa	Ir	2	30	1945			4-23-53	10.	1030		1000	
2dad	Ir	2	30	1945			4-23-53	10.	1030		1000	S
2daa	Ir	2	48	1945	35							
2dbc	Ir	4	38	1952	38	19	2-24-53	12.	1030		992	
2acc	Ir	8	38	1951			2-24-53	10.	1072		994	
2abd2	Ir	8	40	1951			2-24-53	16.	1033		993	
2abc	Ir	12	37	1967	37	23	9-6-67	14.	1033	1019	996	S
2bad	Ir	2	38	1951	38		2-23-53	15.	1032		994	
2bbd	Ir		50	1937			2-23-53	22.5	1040		990	
2bdb	Ir	6	45	1966	43				1035		992	
2cbb	Ir			1968			3-21-73	16.	1031		988	S
2cdd	Ir	2	27	1948			2-23-53	10.				
2cbc	M			1973					1028			S
2abd3	O			1968	40				1032		992	L
2aca1	O			1968	40				1030		990	L
3aac	Ir	12 3/4	37	1973	37	26	2-17-73	11.	1050		1013	
3cbd	Ir	6	31	1966	31		11-4-66	8.	1030		999	
4cba1	In	13 3/8	40	1969	27	17	5-6-69	10.				
4cba2	In	5	35	1969	28	18	5-7-69	10.				

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(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 17 NORTH, RANGE 7 WEST INDIAN MERIDIAN												
4cbb1	In	8	38	1969	28	18	8-13-69	10				
4cbb2	In	8	38	1969	28	18	8-15-69	10				
4cba3	In	8	38	1969	27	22	8-14-69	5				
4cba4	In	8		1969	27	21	8-15-69	6				
4cbb3	In	8		1969	27	21	8-15-69	6				
4bcd	In	8	39	1970	34	21	10-2-70	13				
4cba5	In	8	36	1970	31	23	10-2-70	7.75				
4caa	Ir	6	35	1966	33	23	11-18-66	10	1030	1020	997	
11dba	O	4½	39	1973	38	23	6-6-73	14.90	1025	1010	987	L,S
11dcd	O	4½	33	1973	31	20	6-6-73	10.90	1025	1014	994	L,S
11aab	A	6	36				4-5-73	12.22	1022		986	S
11add	A	4	40				4-5-73	12.16	1025		985	S
11aad	M								1022			S
11aaa	M								1021			S
11adc	S											S
11daa	D											S
11bbd	D											S
11bab1	D											S
11bad	D											S
11bab2	D											S
12bad	Ir								1030			
12bbd	Ir								1030			
12bdd	Ir								1024			
12cdc1	O			1953	35				1023		988	L
12cdb	O			1953	33				1020		987	L
12cac1	O			1953	31				1019		988	L
12cac2	M	15	35	1958	35		3-13-58	4	1019		984	S

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Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 17 NORTH, RANGE 7 WEST INDIAN MERIDIAN												
12cbd	M	15	32		32	25	4-4-73	7.25	1017	1011	985	S
12cca	M	15	32	1950	32	26	4-4-73	6.38	1018	1012	986	S
12ccd	M	15	33	1950	33	33	9-4-52	5	1019		986	S
12cdc2	M	15	34	1950	34		9-4-52	6	1018		984	
12cac	Ir	6	35	1968	35				1018		983	S
12cbd	S	6	22	1972	22							S
12cdd	S	6							1019	1008		S
12daa1	O	4½	26	1973	25	12	6-6-73	12.64	1007	1020	995	L,S
12daa2	A	r					5-16-73	8.04	1020			
13bbb1	M								1022			S
13bbb2	M		30						1021		991	
13bbb3	M		31.6						1020		989	
13bba1	M		37						1016		979	S
13bba	M		30						1016		986	
13bdb	S	1¼										S
14bca	D											S
TOWNSHIP 18 NORTH, RANGE 5 WEST INDIAN MERIDIAN												
13ddd	D											S
19bbb	O			1973	36				1170		1134	L
21ccc	D,S											S
30aaa	S	8					3-20-73	19.00	1161			S
30ddc	D,S	6										S
33bbb	D	6	90	1970					1145			S
34ddd	O			1973	13				1107		1094	L

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(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
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Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness		Water Level		Elevations[2]			Other Data[3]
					Total (ft)	Saturated (ft)	Date	Depth (ft)	S	WT	BR	
TOWNSHIP 18 NORTH, RANGE 7 WEST INDIAN MERIDIAN												
1ddd	O			1948	55				1137		1082	L
1abb	O			1948	10				1130		1120	L
1dcc	O			1948	39				1107		1068	L
1ddb	D,S	6	68									S
1abd	D		48									S
4aac	Ir	16	44	1952	44		2-25-53	12	1100		1056	
4dad	D	36	26				7-31-50	13.25	1097	1084	1061	
6bbd	Ir	16	61	1953	61		2-25-53	25	1149		1088	
8aaa	O				55				1138	1119	1083	L
8ddd	D,S	2	24									S
10aaa	D	6	70				3-6-73	30	1101	1071	1041	
10daa	S	6	30				7-12-50	21.22	1097	1076	1067	S
10ccd	S	60	28				7-14-50	21.56	1060	1038	1032	
11bbb	O			1948					1077			L
12dcc	O			1948	48				1117		1069	L
12ddd	O			1948	50				1118		1068	L
12ccc	O			1948	37				1102		1065	L
12bbb	O			1948	44				1112		1068	L
13acc1	O				56				1116		1058	L
13acc2	O			1948	58				1117		1059	L
13abb	O			1948	58				1117		1059	L
13bcc	O			1948	41				1097		1056	L
13dcc	O			1948	65				1118		1053	L
13acc3	M	12	50	1949	50	25	5-31-49	25	1113	1088	1063	S
13dbc	M	12	59	1949	59	30	5-31-49	29	1117	1088	1058	S
13dcb	M	12	62	1949	62	36	5-31-49	26	1114	1088	1052	
13ddd2	M	10	50	1963	58	36	3-20-73	31.7	1121	1090	1063	S

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface. WT = Water Table; BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 18 NORTH, RANGE 7 WEST INDIAN MERIDIAN												
13ddd1	M	10	60	1963	57		7-15-63	17	1123		1066	
13dda	M	10	50	1963	56		8-1-63	17	1119		1063	
13baa	D		45	1968								S
14bbb	O			1948	33				1098		1065	L
14aba	D	8	42				7-17-50	23.34				
15aac	D,S	6	53	1920			8-1-50	31.71	1097	1066		S
15bba	S	42					7-14-50	18.61				
17ddd	O				48	31		16.50	1101	1084	1053	L
17acc	Ir	12	55	1969	55		9-- -69	7	1120		1065	
18dac	Ir	12	57	1969			7-- -69	15				
19bab	O				50	23		26.80	1104	1077	1054	L
21dcc	D	5	57				7-17-50	30.74	1081	1050	1024	
21aad	D,S		42	1968					1060		1018	S
21cdc	D		50	1951					1090		1040	
23aaa	O			1948	38	13			1101		1063	L
23bab	D,S	6	70	1941								S
23cac	Ir	12	34	1973	34	28	8-25-73		1100	1094	1066	
24ddd	O			1948	56				1125		1069	L
24aad	Ir	12	60	1952					1118		1058	
24add	Ir	12	60	1952			2-26-54		1120		1060	
24aab	D,S		60	1972								S
24cda	Ir	6	55	1967			3-27-67	11.50	1110		1055	
24abb	A		45									S
24cdc	A		50									S
25ccc	D,S	6	27	1889								S
26aaa2	D,S	6	55	1950								
26aab	Ir	6	32	1966			8-13-66	9	1094		1062	

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 18 NORTH, RANGE 7 WEST INDIAN MERIDIAN												
26aba	Ir	6	35	1967			3-27-67	13	1092		1057	
26bcd	Ir	12	42	1970	38		4-4-73	12.5	1090		1052	S
26ccc	D		40	1940								S
26dcc	S											S
26aaa1	A		35									S
27aaa	O				42	26		15.60	1078	1063	1036	L
27aad	Ir	2	20	1967					1080			S
28cdb	D	1¼	31									S
29ddd					44	30		14.10	1040	1026	996	
33bbb	D,S	1¼	25	1972			3-5-73	9				S
34dba	Ir	12	35	1954					1045		1010	
34dab	Ir	12	35	1954					1040		1005	
35baa	Ir	6	30	1970	26		8-6-70	12	1085		1059	S
35aaa	O			1973	47				1080		1033	L
35cca	Ir		30	1952			2-23-53	15	1038		1008	
36cac	Ir	6	49	1965			7----65	5	1085		1036	
TOWNSHIP 19 NORTH, RANGE 6 WEST INDIAN MERIDIAN												
19bca	S											S
28bcb	D,S	42	60									S
31abb	D											S
34bbb	D		39									S
34cbc	D,S		55	1941								S
35ddd	D		50									S

[1] D = Domestic. S = Stock. A = Abandon. Ir = Irrigation. M = Municipal. In = Industrial. O = Observation. T = Test Well Drilled and Plugged.
[2] Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface. WT = Water Table. BR = Bedrock.
[3] L = Lithologic Log Available. S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness		Water Level		Elevations[2]			Other Data[3]
					Total (ft)	Saturated (ft)	Date	Depth (ft)	S	WT	BR	
TOWNSHIP 19 NORTH, RANGE 7 WEST INDIAN MERIDIAN												
9adc	Ir	16	34	1949	34		5-6-79	3.75	1100		1066	
18bcc	D	6	24				8-3-50	18.73	1204	1186		
23ccc	A	216	60					25				
25bab	A	120	50				8-9-45	41				
29ddd	O				74	57		16.80	1150	1133	1076	L
29bbb	D		55				6-7-71	30				
30dca	Ir	16	75				8-3-50	42.19	1183	1141	1108	
30aac	Ir		111		109				1175		1066	
30ddb	Ir	16	91	1949			7-31-52	38				
30dcc	O				92	50		42.2	1182	1140	1090	L
31bbb	O				78	60		17.70	1160	1142	1082	L
31ccd	D	7	68				7-14-50	30.47				
36bdc	A	6	50									S
36cdc	A		47									S
TOWNSHIP 18 NORTH, RANGE 5 WEST INDIAN MERIDIAN												
13ddd	D											S
19bbb	O			1973	36				1170		1134	L
21ccc	D,S											S
30aaa	S	8					3-20-73	19.00	1161			S
30ddc	D,S	6										S
33bbb	D	6		1970					1145			S
34ddd	O			1973	13				1107		1094	L

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness		Water Level		Elevations[2]			Other Data[3]
					Total (ft)	Saturated (ft)	Date	Depth (ft)	S	WT	BR	
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN												
3aab	DS		39				3-19-73	13.6				S
3cbd	O	4½	45	1973	34	20	6-11-73	13.75	1170	1156	1136	L,S
4bbb	D	7 3/8	69	1964			3-19-73	18.39	1169		1100	S
5ddd1	O			1973	38	15			1172		1134	L
5ddd2	D						3-15-73	22.9	1171			
6bbb	O	4½	45	1973	45	21	6-11-73	23.70	1120	1096	1075	L,S
6ddd	O			1973	33				1153		1120	L
7aac	O	4½	30	1973	32		6-11-73	8.62	1150	1141	1118	L,S
7ddd	S	6	103	1971					1130			S
7ccc	D	7	90	1956					1121			S
8dcc	D		93	1933					1160			S
8ccc	O			1973	33				1131		1098	L
9cbc	S						3-15-73	43.2	1170			
9ccc	O			1973	40				1166		1126	L
10ddd1	O			1973	57				1174		1117	L
10ddd2	O	4½	58	1973	55	41	6-11-73	13.60	1174	1160	1119	L
10dac	S	8	100									S
10bbb	O			1973	50				1171		1121	L
10bcc	D											S
12ccc	D											S
14cdc	D											S
15baa	S											S
15cad	O	4½	82	1973	81	73	6-7-73	7.90	1170	1162	1089	L
16aaa	O		80	1973	80				1170		1090	L
16ddd	O		89	1973					1166		1077	L
16ccd	O	4½	67		63		6-7-73	31.70	1170	1138	1007	L,S
17ddd	O			1973	42				1150		1108	L

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface, WT = Water Table, BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN												
17aab	O	4½	58	1973	55	12	6-11-73	42.70	1180	1137	1125	L,S
17bbc	DS		90	1965					1130			S
17bbb	O	4½	41	1973	36		6-11-73	21.25	1130	1109	1094	L,S
17bad	In	8	120				5-1-73	30.3	1140	1110		S
18cdc2	M	12	60	1972	56	24			1114		1058	L
18cdc1	O	5½	66				3-20-73	32.25	1114	1084		S
18dcc2	M	12	60	1973	67				1120		1053	L
18dcc1	O	5½		1973					1120			
18ccc	O			1963	64				1118		1054	L
19aaa	O			1963	55				1120		1065	L
20abb	S	6	80	1939					1130		1050	S
20ccc	O			1963	66				1118		1052	L
20cca1	O	4½	69	1973	67		11-21-73	18.90	1110	1091	1043	L,S
20cca2	O	7	140	1973	67				1110		1043	L,S
21dcc	O	5½	85				5-9-73	23.3	1110			
21ccc	O			1957	64				1113		1049	L
22aaa	O			1973	57				1117		1060	L
22cdd	O	4½	52	1973	47	4	6-7-73	42.90	1170	1127	1123	L
22bbc	DS	6	143	1968					1160			S
22ccc	O			1973	49				1160		1111	L
24bbb	O			1973	22				1184		1164	L
26ddd	D	6	70	1970					1173			S
26adb	D,S	6	90						1174			S
26aaa	O			1973	45				1180		1135	L
27cbc	S	8	80						1140			S
27ccc	O			1973	37				1122		1085	L
28bac	In	5½	82				5-9-73	26.85	1120			

[1] D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
[2] Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
[3] L = Lithologic Log Available; S = Water Analysis Available.

Table A-1 (continued). WATER WELL DATA

Location	Use[1]	Casing Diameter (in)	Well Depth (ft)	Year Drilled	Terrace Thickness Total (ft)	Terrace Thickness Saturated (ft)	Water Level Date	Water Level Depth (ft)	Elevations[2] S	Elevations[2] WT	Elevations[2] BR	Other Data[3]
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN												
28ccc	D	36					5-9-73	9.56	1112			
29ccc	O			1973	50				1100		1050	L
29bbb	S	8										S
29ddd	O			1973	62				1112		1050	L
30abb	O			1963	56				1116		1060	L
31bbb	O			1973	42				1099		1057	L
31baa	O	4½	54	1973	53	33	6-7-73	20.40	1102	1082	1049	L,S
31bac	S	5	50				5-15-73	13.68	1100		1050	
31aac	D	6	57	1969					1100		1043	S
31ccd	S	6										S
31bbd	A	5	39				5-15-73	7.03	1100		1061	S
31ddd1	S											S
31ddd2	O	4½	36	1973	34	27	6-7-73	7.40	1089	1082	1055	L,S
32ccc	O			1973	31				1085		1054	L
32abc	Ir	12	73	1952			7-9-53	25	1103	1078	1005	
32bbd	Ir	16	61	1953			8-12-53	23	1100	1077	1016	
32baa	O	4½	63	1973	60	42	6-7-73	18.35	1105	1087	1045	L,S
32ddc	D											S
33ddc	A	6	57				4-24-73	28.64	1100		1047	S
34ccc1	D,S	6	70	1970					1100			S
34ccc2	O			1973	57				1100		1043	L
35bbb1	O	4½	61	1973	63	40	6-7-73	22.50	1143	1120	1080	L,S
35bbb2	S	8										S
35ccc	D											S
35dcb	S											S
35ddd	O			1973	43				1118		1075	L
36bbb	O			1973	67				1170		1103	L

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation. T = Test Well Drilled and Plugged.
(2) Elevations are Mean Sea Level estimated from U.S. Geologic Survey Topographic Maps with 10 foot contour intervals. S = Surface; WT = Water Table; BR = Bedrock.
(3) L = Lithologic Log Available; S = Water Analysis Available.

Table A-2 WATER QUALITY DATA

Table A-2. WATER QUALITY DATA

Location	Use[1]	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness[2]	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
1acc	D	30	3-30-71	17	7.1	1200	620	835				0.0	100	270	8.8
2cba	spring		3-15-71		7.0	15000							5500		
2acc	D	90	5-18-72		7.5	600	288	380				0.0	35	2.2	14.6
2aba	O	95	9-10-71	17	7.8	850	250		54	28			125	83	21
2baa	O	95	11-10-73		7.6	525		341					73		
2bb1	D	43	9-15-71		7.4	5850	1530		340	166			1650	350	
2bb2	D	56	10-24-72	17	7.3	2000		1600					610		
2bab1	D	65	12-13-72	12	7.4	1536		998					475		
2bab2			3-7-73	13	7.0		545	1110		64	64	1.3	275		1.06
2aaa	S	62	8-3-71		7.6	820	295	548	10				76	115	48
2dba			10-24-72		7.2	650		510					39		
2dca			7-7-72		7.2	950	370					0.0	50	45	6.8
2bbd1	O		3-14-73	17	7.2	1700	650	1105	119	71	136	12.9	475	41	5.08
2bbd2			5-30-73	14	7.0	1900	760	1900	65	85	125	108	425	46	.60
3aab	O	36	6-28-72		7.1	4000	1540	2550				0.0	1400	160	6.5
3abb1	O		3-14-73	17	6.9	5800	1730	3770	56	190	750	11.5	2350	53	5.53
3abb2			6-12-73	17	7.0	5400	1090	350	160	124	642	.2	1875	50	6.84
4aac	O	48	6-27-72		7.3	1650	450	1150				0.0	500	45	1.5
4abb1	S	57	12-19-72		7.2	1906		1239					448		
4bbc1			12-19-72	14	7.1	1850		1202					410		
4bbc2	D	40	8-3-71		7.6	700	395	404					58	80	30
4baa	O		5-30-73	13	7.0	1250	360	813	61	40	145	3.5	275	45	36

(1) D = Domestic S = Stock; A = Abandon, Ir = Irrigation, M = Municipal; In = Industrial, O = Observation, T = Test Well Drilled and Plugged.

(2) Total Hardness expressed in mg/l as $CaCO_3$

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (µmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
5bbb	S	63	10-25-72		7.3	556		358					35		
5cbc	D		12-18-72		7.2	570		370					24		
TOWNSHIP 16 NORTH, RANGE 5 WEST INDIAN MERIDIAN															
3dcc1	Ir	27	7-26-66		7.9	1630	460	1050			189		150	275	.6
3bba	Ir	28	7-26-66		8.1	2290	610	1370			260		420	158	17
TOWNSHIP 17 NORTH, RANGE 3 WEST INDIAN MERIDIAN															
18cbd	D	41	11- 5-72		7.6	891		579					20		
18dca	D	190	11- 4-72		7.1	655		426					22		
19aab	D	175	11- 4-72		7.1	655		426					34		
30ccc	D	30	12- 4-72		7.6	614		399					36		
31bbb	S		10-24-72	15	7.3	610		430					37		
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
10ddd			9-20-72	22	7.9	8000	620	5254					2750	35	<1.0
15ddd	D	50	12- 6-72	14	7.1	922		599					78		
15bdd	D	60	5-17-72		7.1	525	156	340				0.0	6.6	44	35
16daa	D	70	12- 7-72		7.5	998		649					80		
17daa	D	135	12-18-72		7.2	660		429					22		
17dcd	S		12-18-72		7.2	737		479					112		
18ddd	S		12- 5-72		6.8	809		526					78		
19ada	D	101	12- 8-72		7.3	246		160					7		

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.

(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
19bcb	D	175	12- 4-72	14	7.0	1792		1165					255		
19cdd	D		10-25-72	17	6.7	560		364					110		
19ccb	D	74	5-17-72		6.9	750		640				0.0	29	56	220
19cc	D	74	6-14-72		6.9	800		580				0.0	33	47	220
20ada		65	12- 7-72		7.1	368		239					12		
20aba	S		12- 7-72		7.3	799		519					128		
20ccb	D	60+	5-17-72		7.2	4000	220	650				0.0	33	22	23
21aaa	D	70	12- 7-72		8.0	594		386					20		
21bbc	S		12- 7-72		7.0	512		333					36		
21ccc2	PS	68	10-27-72	17	7.0	480		312					51		
21cdc	PS	90	10-27-72	17	7.1	420		273					28		
21cdd	PS	85	10-27-72	17	7.1	450		293					30		
21daa	S	90	12-21-72		8.0	886		576					58		
21dcc	S	100	12-21-72		7.1	174		113					9		
22aab	D	55	6- 7-72		7.3	1250	410	780				0.0	125	41	32.5
22aab2	D	55	12- 6-72	15	7.2	1126		732					138		
22aba	D	60	12- 6-72	15	7.2	1004		652					100		
22bab	S	50	9-18-72	17	7.4	885	360	528					50	40	27
22aaa1	D	68	5-17-72		7.4	1300	240	864				0.0	149	44	152
22aaa2			6-14-72		7.4	1450	580	924				0.0	138	47	153
22aaa3			6-26-72		7.3	1300	580	840				0.0	150	45	4.5
23daa	D	130	5-18-72		7.4	700	292	556				.34	26	44	.4

(1) D = Domestic, S = Stock, A = Abandon, Ir = Irrigation, M = Municipal, In = Industrial, O = Observation, T = Test Well Drilled and Plugged

(2) Total Hardness expressed in mg/l as $CaCO_3$

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
23dcc	D	175	6-18-72		7.5	2700	1660	1972				.36	14	1714	0.0
24ada	S	90	12- 5-72	14	7.3	788		512					32		
24bba1	S	65	12- 4-72	15	7.0	2099		1364					475		
24bba2			5-18-72		7.1	2200	860	1496				.48	478	44	.65
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
24bba	S	65	5-18-72		7.1	2200	860	1496				.48	478	44	.65
25ddc	D		10-24-72	14	7.4	1025		740					175		
25bba	D		8-27-71	19	7.6	775	355	586					60	30	27
26dcd1	O	27	6-29-72		7.5	875	254	596				0.0	100	10	11.6
26dcd2			6-30-72		7.4	950	346	610				0.0	140	55	11.6
26dcc1	D		8-17-71		8.1	800	335	534					52	145	0.8
26dcc2			7-19-72		7.6	820	302	496					40	65	2.0
27cbb1	O		3-15-73	16	7.1	7800	1650	5070	272	130	3625	220	3425	60	0.36
27cbb2			6-12-73	17		1150	364	748	31	20	154	5.4	200	50	5.12
27dda			11- 2-72	15	7.4	510		232					44		
27dcc1	O	58	6-22-72		7.1	9000	1780	6200				0.0	3300	150	3.0
27dcc2			6-23-72		7.1	9000		5900				0.0	3500		
27aba	S	45	5-17-72		7.1	7250	3700	5000				0.14	2820	44	9.5
27bba	D		5-17-72		7.3	4000	1740	3190				0.82	1300	67	21.5
27aa	S		12-21-72		7.2	4149		2697					1275		
27cdc1	O	33	3-15-73	15	7.5	1300	270	845	35	27	210	103	338	64	2.16

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (µmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
27cdc2	O	33	6-12-73	16		1700	400	1105	45	24	230	6.2	375	45	4.20
28ddb1	O	63	9-21-72	17	7.4	3350	320	2050					990	27	4.0
28ddb2	O	63	9-22-72	17	7.1	3300	340	2024					1010	31	4.5
28ccd1	D		5-18-72		7.1	310	84	200				.08	18	28	21.5
28ccd2	D		11- 2-72	14	7.3	300		195					14		
28cdc	Ir		9-14-72	16	7.4	525	160	324					32	22	22
29ccb1	DS	60	5-18-72		7.0	475	120	264				0.0	44	80	14.9
29ccb2			11- 8-72		7.1	450		293					40		
29dcb	Ir	68	11- 9-72		7.2	310		202					16		
29dda1	D	64	11- 9-72		7.0	330		215					16		
30ddd	S		11-10-72		7.2	1120		728					242		
31cdd1	DS	50	12-25-72	17	6.9	320		208					10		
31cdd2			5-18 72		7.2	325	96	211				.08	11	33	29
31bad	S	78	11-15-72		7.2	275		179					19		
31ccc			11-20-73		7.5	237		284					51	33	4.0
32cdc		58	12-19-72	15	7.5	628		408					32		
32bbb2	S	60	11-16-72		7.3	350		228					66		
32bba	A	60	11-16-72		6.9	910		592					205		
32aad			11-10-72		7.5	380		247					23		
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
33aab	O	64	3-14-73	16	7.1	3000	380	1950	71	31	530	25.4	1025	3.5	5.34

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
33aab2			5-30-73	14	7.0	3300	400	2154	65	35	530	25.4	1250	50	1.31
33bbb	D	75	11- 9-72	15	7.2	350		228					16		
33bba1	A	32	11 8-72		7.8	256		166					23		
33bba2			12-13-72	23	7.8	256		166					23		
33bab1	Ir	50	12-21-72		7.1	370		240					15		
33bab2			12-21-72		7.0	364		237					15		
33bab3			6-12-73	16		700	362	455	51	42	25	.2	9		.62
33bab4			11- 1-73		7.0	330		215					15		
33abb1	D		5-18-73		7.1	550	144	340					44	39	6.4
33abb2			11- 2-73	14	7.3	480		312					40		
34dad			11-10-72		7.2	7500		4875					3050		
34aab1	O	75	3-15-73	14	7.2	1600	330	1046	32	31	250	184	538	95	< .2
34aab2			5-30-73	13	7.0	2000	380	1300	45	45	300	4.7	450	50	.68
34abb	O	54	3-15-73	14	7.5	1700	360	1110	82	33	280	< 1.0	463	64	2.86
34bab1	O	43	3-15-73	14	7.4	1050	175	684	19	20	192	250	263	36	0.22
34bab2			5-30-73	14	7.0	1050	260	683	6	35	180	150	200	42	.63
34bbb1	O	63	3-15-73	15	6.7	4200	530	2730	48	29	805	425	1525	39	5.84
34bbb2			5-30-73	14	7.0	4000	480	2600	130	45	750	6.2	1150	54	1.27
34ccb	O	69	3-15-73	15	7.0	15000	2230	9750	390	200	7550	175	7150	68	15.60
34dcc	O	22	3-14-73	16	7.1	9800	3760	6370	3000	380	1180	< 1.0	4150	50	< 0.2
32cdc1	O	55	3-14-73	16	6.7	19000	3500	12400	3500	260	4200	12.3	8762	72	5.66
34cdc2			6-12-73	17	7.0	19000	3250	12350	800	190	3950	< .2	8925	48	3.64

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN															
34cdd	A	32	11-10-72		7.7	3000		1950					562		
35bbb	Ir	45	12- 1-72		7.3	287		186					12		
35dcc	D	102	8-24-71		7.6	1500	435	826					310	110	0.21
35ddc	D	90	10-24-72	14	7.3	700		540					57		58.8
35aaa	D	105	10-24-72	15	7.2	610		400					85		40
35aab1	S	24	10-24-72	17	7.2	925		660					130		
35aab2			10-24-72	17	7.5	600		460					31		
35baa	Ir		8-10-72		7.6	920	350	596					82	40	
36cca	S		10-24-72	9	7.3	510		410					30		
36dcd	S	28	11- 2-72		7.3	600		390					30		
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN															
4cbb	S		3-19-73	15	7.3	700	240	455	60	24	72	6.4	90	35	6.81
4bbb			11-21-73		7.5	710	253	352					61	40	5.0
5ccc	D		3-19-73	16	6.8	800		520	65	27	89	< 1.0	100	50	18.3
6bba	O	66	11-21-73	62	7.3	800	278	368					94	43	4.0
6ccc	D		3-19-73	14	6.6	430		280	32	13	51	<1.0	15	33	8.8
6bba			11-21-73		7.3	800	278	368					94	43	4.0
7cdd	D	105	3-19-73	16	6.9	1050	300	683	68	30	140	1.0	220	85	2.3
7dbb	Ir	46	6- 5-68		8.4	780	276	480			62		90	51	39
8ccc	S		3-19-73	15	6.8	650	250	423	61	24	59	1.0	170	41	11.9
9ddd			3-19-73	15	7.0	970	310	630	74	30	128	1.0	150	150	3.0

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (µmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN															
10dcc			11-20-73		7.5	910	381	436					51	69	0.0
13dda	D	93	12-13-72	14	6.7	660		429					68		
13ddd			11-20-73		7.2	600	186	252					162	32	2.6
14dda		96	12-13-72		6.8	758		493					120		
14cbc	O	61	11-20-73		7.5	112		220					25	26	4.9
16aaa	D		3-19-73	14	6.9	900	330	585	85	30	101	1.0	135	68	6.4
17bba	D		3-19-73	16	6.8	1000	360	650	88	33	101	1.0	190	70	6.6
18bba	D	80	3-19-73	16	6.8	600	220	390	50	20	59	3.5	70	41	6.5
18ccc			11-20-73		7.6	600	247	304					46	32	2.8
20aac1	O	42	11-20-73	60	7.4	1100	516	524					149	61	5.03
20aac2			11-20-73		7.4	1100	516	524					149	61	5.03
24abb	D	73	12-13-72	12	6.8	252		164					17		
24bbc	D	90	12-13-72		6.6	474		308					34		
25ccc	D	60	11-15-72	12	7.2	550		358					41		
25dcd	DS		11-10-72	14	7.4	460		299					35		
26ccc	D		11-16-72	14	7.3	350		228					22		
27ddd			11-20-72		8.1	360	155	128					19	21	3.9
30cdb	PS	45	4-29-67		8.5	1660	312	972			251		260	158	.5
32bbd1	Ir	37	4-28-67		7.9	379	100	253			46		16	25	39
32bbd2			7-30-68		8.0	4900	960	3060			671		1450	800	.8
35ada	D	51	11-15-72	14	7.3	650		423					66		
35aaa	D	65	11-15-72	14	6.9	1100		715					232		

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN															
35bab	D	40	11-15-72	15	7.5	450		293					38		
36bbc	D	65	11-16-72	15	7.2	660		429					82		
TOWNSHIP 17 NORTH, RANGE 6 WEST INDIAN MERIDIAN															
2aaa1	D	102	3-21-73	13	6.7	650	265	423	68	24	64	<1.0	220	85	6.4
2aaa2	O	42	6- 6-73	14	7.0	760	450	494	39	60	161	113	100	37	6.0
3abb	S		3-21-73	15	6.8	358	280	358	43	17	72	<1.0	140	26	7.1
4dcd	DS		6- 2-72		6.6	4000	1470	3192				.04	1320	41	12.0
5aba	DS	60	3-21-73	15	6.5	600	205	390	50	18	66	1.0	200	35	7.9
7aad	S		3-20-73	15	7.2	600	2451	390	72	28	56	1.0	80	40	11.4
9add	D		4-30-71	16		800	395	880				.02	204	82	18.3
9bbb1	D		3-19-73	14	7.3	700	165	455	42	19	106	1.0	95	37	8.4
9bbb2			6- 2-72		7.2	800	190	496				.02	66	46	31
10dad	S		3-19-73	15	6.8	900	280	585	69	28	110	4.0	145	63	6.1
11ccc1	D		3-19-73	14	7.0	1200	405	780	91	48	144	< 1.0	225	93	9.7
11cc2	D		4- 5-73	15	7.2	1400	450	910	82	49	163	< 1.0	215	48	5.6
11ddd	O	59	6- 6-73	14	7.0	750	300	488	39	20	81	.5	80	55	8.4
12aaa	O	75	6- 7 73	14	7.0	620	225	403	27	20	75	4.3	40	47	10.8
12ccd	D		3-19-73	15	6.8	900	320	585	79	31	91	< 1.0	155	56	8.0
14aad	D	22	3-20-73	15	6.8	900	585	585	80	31	91	1.0	240	63	18.9
15ddb	Ir	33	4- 4-73	13	7.2	1900	250	1235	58	19	166	4.1	495	78	.93
16aaa	D	50	3-20-73	15	7.0	1800	645	1170	122	60	280	2.2	880	138	7.7

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (µmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO4 (mg/1)	NO3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 6 WEST INDIAN MERIDIAN															
16aaa2			4- 5-73	15	7.5	2000	620	1300	136	64	220	<1.0	470	83	1.4
16aaa3			6-11-73	15	7.0	2000	740	1300	70	58	177	< .2	425	120	5.1
17bbb	S	22	4- 4-73	15	7.4	620	285	403	76	26	16	1.0	47	28	7.5
17bcc	S	7.2	4- 4-73	12	7.2	1550	340	100	50	51	226	<1.0	302	63	3.7
18bcc	O	30	6- 6-73	14	7.0	1025	325	660	50	20	157	.2	175	108	.13
18bba	Ir	35	6- 2-72		7.4	1050	365	572					12.1	71	.7
19bbb	DS		5-18-72		7.5	1100	240	700				.08	149	56	14.7
TOWNSHIP 17 NORTH, RANGE 7 WEST INDIAN MERIDIAN															
2dbd2	O	41½	6- 6-73	14	7.0	1850	500	1203	110	52	130	2.1	100	230	.05
2aca2	PS	32	6- 2-72		7.4	925	310	925				.04	86	46	29
2aca3			4-25-73	18	7.2	950	400	617	60	37	74	0.2	72	19	2.9
2abd1	PS	32	6- 2-72		7.4	1050	380	588				0.0	77	66	56.5
2dbd			4-25-73	16	7.2	325	340	536	51	27	71	0.8	80	19	2.0
2ddb	Ir	35	6- 2-72		7.4	900	346	568					86	61	0.0
2abc	Ir	37	5-24-72		7.7	900	356	616					88	67	6.5
2dad	Ir	30	8-17-71	18		850	387		104	32			70	125	
2cbb	Ir		3- 2-73	16	7.3	1100	410	792					138	125	
2cbc	PS		4- 4-73	15	8.1	580	210	377	56	20	56	4.0	33	13	3.6
11dba	O	39	6- 6-73	14	7.0	7000	1300	4550	205	92	1309	< .2	2350	200	.1
11dcd	O	33	6- 6-73	14	7.0	12250	1850	7963	400	140	2490	2.6	4150	490	.05
11aab	A	36	4- 5-73	16	7.2	1240	400	806	82	49	164	50	107	128	.09

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.

(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 7 WEST INDIAN MERIDIAN															
11adc1	S	36	9- 8-71		7.8	1300	385		82	44			125	240	.09
11adc2			4- 5-73	16	7.2	4500	885	2925	169	90	770	1.0	1350	95	.05
11add1	A	40	9- 8-71		8.1	1300	315	354	91	21			140	245	
11add2			4- 5-73	16	7.8	1300	385	845	85	45	840	1.5	120	85	.20
11aaa1	PS		8-18-71	19	8.0	1300	286	686	74	26	167		215	93	1.05
11aaa2			4- 5-73	16	7.2	800	320	520	80	20	66	1.0	44	40	.07
11aad1	PS		6- 2-72		7.3	1100	390	680				.14	83	97	0.0
11aad2			8-18-71	18	7.8	1200	362	734	86	37	109		105	115	1.18
11aad3			4- 5-73	16	7.3	1100	420	115	82	46	116	4.0	66	70	.09
11daa1	D		6- 1-72		7.4	4700	740	2952				0.0	1452	194	0.0
11daa2			9- 7-71	24	7.7	3800	625	1320	158	56			1050	230	
11daa3			4- 5-73	16	7.8	5500	720	3575	157	70	1130	4.0	1725	85	.25
11bbd1	D		5-24-72		7.5	700	228	456				0.0	55	61	11.3
11bbd2	D		8-17-71	21	8.0	700	272	352	81	18	35		32	33	17
11bbd3	D		4- 4-73	13	7.6	800	250	520	68	25	59	< 1.0	72	38	.43
11bab1	D		8-17-71		7.6	700	204	488				.04	77	56	15
11bab2	D		4- 5-73	16	7.4	720	270	468	65	20	86	< 1.0	60	23	.88
11bab3	D		4- 5-73	15	7.3	7300	960	4745	148	81	1908	< 1.0	2100	555	< .02
11bad	D		4- 5-73	16	7.4	1750	520	1137	96	50	216	1.0	290	183	.1

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 17 NORTH, RANGE 7 WEST INDIAN MERIDIAN															
12cac	PS	35	8-18-71	18	7.9	1000	367	554	86	38	61	0.0	66	68	.53
12cac	PS	35	4- 4-73	16	7.2	1400	460	910	100	51	134	<1.0	210	75	.31
12cbd	PS		4- 4-73	14	7.6	950	420	618	99	32	46	1.0	106	53	10.60
12cca	PS	32	4- 4-73	16	7.4	2300	470	1495	110	48	258	<1.0	660	70	.93
12ccd	PS	33	4- 4-73	14	7.4	1400	2951	910	79	27	153	<1.0	265	43	2.08
12cac1	Ir	35	5-10-73	16	7.6	900	400	585	58	35	78	< .5	83	117	.11
12cac2			5-24-72		7.3	900	338	652				.04	88	116	1.3
12cdd1	S		4- 4-73	16	7.5	1300	300	845	76	33	170	1.0	230	40	.10
12cdd2			5-24-72		7.5	1100	278	720				0.12	176	100	0.0
12cbd	S	22	4- 4-73	15	7.5	860	390	559	88	37	59	<1.0	40	58	.41
12daa1	O	26	6- 6-73	14	7.0	990	300	644	55	28	102	.5	120	71	65
13bbb1	A	32	4- 4-73	15	8.3	1700	170	1105	45	20	360	1.0	390	10	.87
13bba1	A	30	4- 4-73	14	7.8	1900	205	1235	129	65	1000	17.5	455	63	31
13bdb	A		8-18-71	18	8.1	1400	316	716	86	25	177		230	85	.66
TOWNSHIP 18 NORTH, RANGE 5 WEST INDIAN MERIDIAN															
13ddd	D		3-20-73	12	6.7	1300	385	845	113	54	107	1.0	260	53	1.5
21ccc	DS		3-20-73	14	7.1	800	420	520	68	32	89	1.0	70	56	2.3
30aaa	S		3-20-73	14	7.2	1400	520	910	90	50	170	2.4	170	258	4.9
30ddc	Ds		3-20-73	13	6.8	800	190	520	70	35	72	1.0	120	28	6.4
33bbb	D		3-20-73	15	7.1	650	310	423	52	18	100	17.2	30	20	2.2

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (µmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN															
3aab	Ds		3-19-73	16	7.1	640	360	416	55	54	22	113	55	21	
3cbd	O	45	6-11-73	16	7.0	540	260	351	37	22	39	2.6	18	16	.10
4bbb1	D	69	3-19-73	15	7.0	850	480	553	100	270	30	1.0	50	34	20
6bbb	O	45	6-11-73	15	7.0	1700	330	1105	110	44	184	1.4	300	39	7.0
7aac	O	30	6-11-73	15	7.0	800	290	520	41	32	90	2.4	30	35	4.05
7ddd	S	103	3- 6-73	16	7.6	2300	270	1500					888	200	<0.2
7ccc	D	90	3- 6-73	12	7.3	640	260	416					113	34	8.8
8dcc	D	93	3- 7-73	11	7.1	1200	535	780					175	39	41.5
10dac	S	100	5- 3-73	16	8.0	950	200	617	24	28	133	< .5	181	77	< .02
10bcc	D		3-19-73		7.4	550	130	358	26	15	86	1.0	38	25	0.3
12ccc	D		3-19-73		7.6	600	220	390	52	24	31	1.0	20	26	8.9
14cdc	D		3-21-73	14	7.2	700	265	455	52	33	69	1.0	90	22	7.7
15baa	S		5- 3-73	15	7.4	2600	780	1690	190	62	281	< .5	598	32	< .02
16ccd	O	67	6- 7-73	14	7.0	1100	400	715	60	34	112	1.4	180	43	1.57
17aab	O	58	6-11-73	20	7.0	1250	430	813	120	34	99	17.0	205	51	5.9
17bbc	DS	90	3- 9-73	16	7.1	900	410	585	82	46	58	1.0	200		11.9
17bbb	O	41	6-11-73	16	7.0	1375	530	894	120	56	74	3.7	238	33	6.7
17bad	In	120	5- 1-73	20	7.6	15500	2950	10075	460	240	3008	2.0	4950	838	.02
18cdc	O	66	3-21-73	15	7.0	1100	330	715	91	30	131	2.8	220	42	6.9
20abb	S	80	3-20-73	16	7.2	2800	580	1820	110	67	140	1.5	675	28	2.0
20cca1			11-21-73		7.7	4300	907	2588					1074	495	2.2
20cca2			11-21-73		7.4	1000	299	512					143	51	2.3
22bbc	DS	143	3-21-73	16	7.3	1350	270	878	59	29	213	1.0	220	78	0.8

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (μmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 18 NORTH, RANGE 7 WEST INDIAN MERIDIAN															
33bbb	DS	25	3- 5-73	12	7.6	500	220	325					50	24	7.8
35baa	Ir	30	10- 6-70		7.8	562	216	332			34		37	38	24
TOWNSHIP 19 NORTH, RANGE 6 WEST INDIAN MERIDIAN															
19bcc	S		3-19-73	16	7.1	2000	505	1300	104	62	270	5.6	510	40	10.9
28bcb	DS	60	3-19-73	15	7.3	800	225	520	45	28	112	1.0	110	88	.40
31abb	D		3-19-73	15	7.4	1200	280	780	54	42	186	<1.0	220	18	29
34bbb	D		3-19-73	16	7.2	550	210	358	48	23	57	<1.0	35	19	4.6
34cbc	DS	55	4-26-73	15	7.5			1675	158	55	44	< .2	1050		
35ddd	D	50	3-19-73		7.0	1200	425	780	98	44	109	1.0	180	20	< .20
TOWNSHIP 19 NORTH, RANGE 7 WEST INDIAN MERIDIAN															
36bdc	A	50	9- 9-45	17			180	344	52	12	73		20	8	11
36cdc	A	47	9- 9-45	17			520	870	146	38	45		226	18	141

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = Industrial; O = Observation; T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (µmhos)	Total Hardness	Total Dissolved Solids (mg/1)	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Fe (mg/1)	Cl (mg/1)	SO_4 (mg/1)	NO_3 (mg/1)
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN															
26ddd	D	70	4-26-73	16	6.9	600	280	390	35	16	58	0.2	23	15	5.3
26adb	DS	90	3-21-73	14	7.1	700	260	455	63	25	74	1.0	95	24	14.0
27abc	S	80	3-21 73	16	7.1	800	310	520	68	33	76	1.0	105	85	5.6
29bbb	S		3-21-73	16	6.8	750	225	488	60	21	91	1.0	110	28	11.3
31baa	O	54	6- 7-73	14	6.5	440	250	286	22	12	76	.2	40	24	7.2
31aac	D	57	4-26-73	17	7.3	600	240	390	43	17	50	.2	82	28	0.6
31ccd	S		3-21-73	15	6.9	525	320	341	50	19	51	1.0	50	35	15.2
31ddd1	S		4-24-73	15	7.4	600	240	390	39	15	41	0.2	71	16	2.2
31ddd2	O	36	6- 7-73	13	7.0	625	350	406	39	18	45	0.4	90	35	3.4
32baa	O	63	6- 7-73	14	7.0	800	350	520	35	22	93	.8	100	39	2.2
32ddc			4-24-73	16	7.4	900	260	585	44	20	98	.4	150	18	1.3
33ddc	A	57	4-24-73	17	8.0	2500	140	1625	35	7	131	20	200	13	< .02
34ccc	DS	70	4-24-73	17	7.1	850	250	552	44	20	90	0.2	100	29	.35
35bbb1	O	61	6- 7-73	14	9.0	1420	600	923	6.5	42	162	2.7	90	324	1.05
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN															
35bbb2	S		4-26-73	16	7.2	1800	580	1170	118	50	198	0.2	225	83	2.3
35ccc	D		4-24-73	17	7.0	1550	440	1007	83	47	178	0.2	252	99	.60
35dcb	S		4-25-73	17	7.0	800	340	520	68	19	69	0.6	73	23	1.2
TOWNSHIP 18 NORTH, RANGE 7 WEST INDIAN MERIDIAN															
1ddb	DS	68	7-10-45	18			720	1290	198	55	156		414	34	120
1abd	D	48	9- 9-45	18			254	434	72	18	40		74	10	55

(1) D = Domestic, S = Stock, A = Abandon, Ir = Irrigation, M = Municipal, In = Industrial, O = Observation, T = Test Well Drilled and Plugged.
(2) Total Hardness expressed in mg l as $CaCO_3$

Table A-2 (continued). WATER QUALITY DATA

Location	Use	Well Depth in Feet	Date of Sample	Temperature (°C)	pH	Specific Conductance (µmhos)	Total Hardness	Total Dissolved Solids (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	Fe (mg/l)	Cl (mg/l)	SO_4 (mg/l)	NO_3 (mg/l)
TOWNSHIP 18 NORTH, RANGE 7 WEST INDIAN MERIDIAN															
8ddd	DS	24	10- 4-50			534	206	326	58	15	25		53	20	17
10dda	D	70	3- 6-73	15	7.4	750	205	488					125	45	12.6
13acc3	PS	50	12-13-50			1300	424	825	114	34	95		250	25	26
13dbc	PS	59	3-20-73	16	6.8	650	215	423	58	20	43	1.0	100	53	6.9
13ddd2	PS	50	3-20-73	16	6.7	1000	315	650	79	29	87	1.0	125	88	8.9
13baa1	D	45	3- 6-73	15	7.0	500	180	325					88	29	6.6
13baa2	D	45	7-10-45	17			121	246	32	10	22		19	12	28
15aac	DS	53	10- 5-50	16		809	330	578	91	25	42		36	13	162
21aad	DS	42	4- 5-73	16	8.1	610	280	397	58	28	36	1.0	34	20	6.8
23bab	DS	70	3- 5-73	14	7.9	450	125	293					38	44	2.9
24cdc	A	50	7-10-45	17			491	1250	144	32	172		381	36	59
24aab	DS	60	3- 5-73	15	6.8	1050	350	683					375	44	7.2
24abb	A	45	7-10-45	17			419	740	102	40	79		216	39	12
25ccc	DS	27	3- 5-73	17	6.9	1100	330	715					300	35	16.1
26aaa1	A	35	7-10-45	18			248	596	50	30	101		108	49	26
26aaa2	DS	55	3- 2-73	16	7.6	700	220	492					78	39	
26bcd1	Ir	42	5-18-72		7.4	625	222	396					65	36	.43
26bcd2			4- 4-73	15	7.1	940	130	611	42	19	245	2.9	211	38	.15
26ccc			4- 4-73	15	7.7	1200	165	780	39	21	200	1.0	238	35	2.5
26dcc	S		4- 4-73	15	7.5	3900	500	2535	70	38	98	7.8	1050	193	.41
27aad	Ir	20	4- 5-73	13	7.3	540	200	351	55	20	41	1.0	48	16	10.7
28cdb	D	31	10- 4-50			314	125	202	35	9.1	15		4	14	50

(1) D = Domestic; S = Stock; A = Abandon; Ir = Irrigation; M = Municipal; In = industrial; O = Observation; T = Test Well Drilled and Plugged.

(2) Total Hardness expressed in mg/l as $CaCO_3$.

Table A-3 WATER QUALITY DATA - OIL FIELD BRINES

Table A-3. WATER QUALITY DATA - OIL FIELD BRINES

Location	Field	Producing Zone	Well Depth in Feet	Date of Sample	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Cl (mg/1)	HCO_3 (mg/1)	SO_4 (mg/1)	Total Dissolved Solids (mg/1)
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN											
Sec. 3	Crescent-Lovell	Layton	4945-5008	7-14-53	10700	1290	52300	103000	79	394	167763
Sec. 23	Crescent-Lovell	Layton	4992-5012	7-14-53	17100	2700	67500	142000	18	220	
Sec. 26	Crescent-Lovell	Layton	4967-4932	7-14-53	15500	2480	69700	142000	0	214	
Sec. 27	Crescent-Lovell	Layton	4876-4937	7-14-53	12500	1840	61400	122000	0	184	
Sec. 27	Crescent	Layton		4-10-68	23945	0	57770	155334	0	126	
Sec. 33	Crescent	Wilcox		4-10-68	19072	0	50615	144340	51	330	
Sec. 28	Crescent	2nd Wilcox		4-10-68	21008	0	52905	143810	32	310	
TOWNSHIP 17 NORTH, RANGE 3 WEST INDIAN MERIDIAN											
Sec. 15	Crescent E	Layton	4713-4809	7-14-73	18100	2340	83200	167000	24	174	270888
Sec. 11	Lowrie W	1st Wilcox	6119-6123	7-14-73	14600	2540	70100	141000	82	479	228801
TOWNSHIP 18 NORTH, RANGE 4 WEST INDIAN MERIDIAN											
Sec. 11	Hull	Middle Layton	4730-4746	5-18-54	18000	3480	76800	160000	79	330	258669
Sec. 4	Lovell N	Tonkawa	4018-4200	5-18-54	16500	3140	76400	156000	0	117	252157
Sec. 22	Lovell	Upper Layton	4645-4800	10-17-55	18000	3210	79000	163000	42	266	263510
Sec. 17	Lovell	Layton	4608-4616	5-18-54	16400	2970	78800	159000	46	156	237372

Table A-3. WATER QUALITY DATA - OIL FIELD BRINES

Location	Field	Producing Zone	Well Depth in Feet	Date of Sample	Ca (mg/1)	Mg (mg/1)	Na (mg/1)	Cl (mg/1)	HCO_3(mg/1)	SO_4 (mg/1)	Total Dissolved Solids (mg/1)
TOWNSHIP 18 NORTH, RANGE 4 WEST INDIAN MERIDIAN											
Sec. 22	Lovell	1st Layton	4630-4676	11-22-54	18500	3100	78300	161000	88	1970	262958
Sec. 22	Lovell	Middle Layton	4828-4833		13600	1850	60200	121000	24	1810	198484
Sec. 36	Lovell SE	Layton	4820-4850	9-1-53	10900	1520	54800	108000	61	205	175496

Table A-4 RESISTIVITY STATIONS

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9	2-10	3-1	3-2	3-3	3-4	3-5
4	1680	3064	39	60	400	346	460	636	476	776	464	166	512	232	
8	1424	2296	62	77	166	317	349	326	345	544	416	14	451	234	
12	1392	1992	76	90	94	361	291	205	230	343	388	22	384	410	
16	1280	1920	81	98	84	402	250	139	190	218	328	17	320	357	
20	1144	1868	84	100	90	418	225	123	186	140	300	17	272	320	
24	1008	1785	91	95	100	428	210	120	167	114	275	18	212	298	
28	913	1680	99	92	106	432	202	123	157	108	258	20	181	280	
32	787	1664	105	88		429	200	127	158	109	238	22	153	258	
36	688	1548	106	87		422	199	130	152	112	218	24	133	247	
40	595	1424	103	86		418	197	134	153		194	26	120	235	
44	554	1320	97	85		395	193	138	151		172	27	112	232	
48	500	1210	90	84		375	188	141	136		155	30	106	229	
52	445	1134					187	144	148		140	31	100	228	
56	407	1050					191	147	147		129	33	100	226	
60	374	990					197	151	148		120	35	100	231	
64	350	920					207	155	214		114	36	100	221	
68	337	950							156		110	37	99	224	
72									154		104	40	100	221	
76									158		100	41	101	217	
80									162		93	45	101	215	
84									165		88	46	102	214	
88									164		84	47	103	215	
92									165		80	51	104	212	
96									162		75	56	104	211	
100									165		75	55	105		
104									166		75	54			
108									167		76	53			
112									166		76	53			
116									164		77	54			
120									164		78	55			
124									166		80	56			
128									163		81	58			
132									165						
136															
140															

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	3-6	3-7	3-8	3-9	3-10	3-11	3-12	3-13	3-14	3-15	3-16	3-17	3-18	3-19	3-20
4	141	283	126	740	232	1012	720	328	525	322	528	440	21	29	416
8	82	172	117	374	236	677	326	216	292	295	502	381	13	45	717
12	60	139	114	226	216	569	168	175	222	294	311	240	16	58	853
16	53	127	114	116	216	509	108	153	176	186	174	138	18	63	985
20	57	123	120	142	216	473	77	143	139	166	90	82	20	66	950
24	70	120	120	124	264	452	57	140	129	153	50	58	24	72	668
28	85	116	119	116	210	430	48	144	119	143	36	43	26	79	520
32	89	107	116	107	197	407	45	147	104	136	31	37			116
36	88	100	112	96	193	375	46	145	97	129	29	36			351
40	83	90	105	93	188	345	45	139	93	123	30	34			306
44	77	82	98	90	178	310	44	130	82	117	32	35			280
48	65	77	89	88	166	276	42	120	70	109	34	36			266
52	60	70	80	81	158	244	43	113		103		37			261
56	56	65	73	85	146	212	45	107		98		40			257
60	54	62	67	72	142		48	103		92		41			252
64	50	54	62	82	132		53	100		86		42			246
68	48	49	59	85	127		57					43			240
72	46	46	56	75	117		58					44			235
76	44	43	53	68	100		58					43			229
80	43		51	68	105		57					44			223
84	42		48	64	100							45			
88	41		47	64	92							46			
92	40		45	66	85							47			
96	39		43	64	79							48			
100	38		42	60	75							47			
104	37		41		72										
108			40		69										
112			39		68										
116			39		64										
120			39		68										
124			39												
128			39												
132															
136															
140															

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	3-21	3-22	3-23	3-24	3-25	3-26	3-27	3-28	3-29	3-30	4-1	4-2	4-3	4-4	4-5
4	988	3768	372	333	220	332	544	408	324	76	261	367	434	659	646
8	723	2496	420	318	187	334	498	349	344	115	235	230	275	420	483
12	470	1200	449	377	132	252	432	348	337	157	213	194	228	283	360
16	237	730	464	402	110		358	394	330	200	192	180	234	220	280
20	177	350	488	424	197		302	462	329	248	175	174	239	181	224
24	135	220	535	444			242	511	330	306	158	174	222	180	192
28	115	191	567	479			209	560	331	335	146	164	213	180	168
32	107	190	569				195	582	333	346	137	158	205	180	152
36	109	179	609				187	608	332	351	134	162	205	178	145
40	114		631				181	620	328	350	133	157	193	170	125
44	120		653				177	647	323	345	137	153	191	164	112
48	127		677				174	672	316	337	136	152	178	160	103
52	134		685				173	676	307	324	130	150	176	142	100
56	142		687				170	678	297	310	117	145	167	140	100
60	148		687				168	654	287	297	113	146	160	144	109
64	155		685				166	653	275	285	112	141	154	150	
68			687							275	113	142	150	143	
72										266	114	141	144	140	
76										258	116	143	132	126	
80										253	114	134	141		
84											113	141			
88											111	139			
92											108	136			
96											103	137			
100											103	135			
104											104	133			
108											104	134			
112											104	131			
116											107	129			
120											110	126			
124											113				
128											116				
132															
136															
140															

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	4-6	4-7	4-8	4-9	4-10	4-11	4-12	4-13	4-14	4-15	4-16	4-17	4-18	4-19	4-20
4	246	49	95		3212	329	344	195	188	[illegible]	323	210	308	298	536
8	166	58	76	885	2022	318	336	204	248	314	290	177	279	184	486
12	148	56	78	410	1000	304	294	202	242	256	243	184	237	[illegible]	457
16	148	64	83	255	465	299	250	194	224	198	176	190	176	107	437
20	146	60	84	175	258	298	[illegible]	187	214	175	150	206	157	100	387
24	142	76	84	132	167	305	214	180	208	158	138	210	148		303
28	137	73	84	118	123	297	210	175	204	145	132	218	144	92	255
32	132	89	82	105	111	291	207	170	196	134	124	216	141	89	233
36	124	75	82	95	104	278	200	166	189	126	118	214	139	87	201
40	123	102	83	90	103	287	190	163	183	118	111	210	137	86	185
44	121			85	101	281	180	159	175	113		203			172
48	121			81	98	278	172	155	168	107		220			162
52	120			80	93	272	170					215			153
56				79	90	273	165					198			146
60				78	89	271	160								140
64				75	86	251	152								134
68				75	86	262									131
72				71	86										127
76				71	87										123
80				70	85										120
84															119
88															117
92															116
96															115
100															112
104															119
108															115
112															102
116															
120															
124															
128															
132															
136															
140															

Table A-4. Resistivity Stations

"A" Space	Resistivity Station														
	5-1	5-2	13-1	13-2	14-1	15-1	16-1	16-2	19-1	20-1	21-1	21-2	21-3	21-4	21-5
4	164	916	3292	484	226	1320	4830	1880	436	1860	308	2068	714	5840	2616
8	178	505	653	84	172	832	4400	4096	218	470	745	1368	364	2530	1784
12	184	340	355	45	140	425	2800	2370	120	313	342	254	240	1960	1160
16	197	348	222	39	122	304	1648	773	97	253	344	250	181	797	724
20	212	212	165	39	105	250	1150	460	100	212	337	96	173	400	342
24	216	181	134	40	92	240	740	280	104	183	325	106	176	210	416
28	226	164	115	40	85	211	410	180	120	165	312	113	175	166	402
32	221	150	106	42	82	179	128	105	129	152	296	130	167	116	384
36	219	140	95	42	81	164	110	92	142	110	279	178	160	178	350
40	215	131	77	43	80	168	95	84	140	[illegible]	266	114	152	98	303
44	215	123	65	44	78	154	82	77	130	125	240	191	149	92	284
48	210	115	59	46	76		70	76	158	119	219	121	146	89	247
52	201	107	56	47	68		64	[illegible]	154	[illegible]	202	[illegible]	142	[illegible]	230
56	197	99	55	48	65		60	67	162	123	187	101	136	94	211
60	191	92	55	49	64		59	65	167	124	173	151	[illegible]	97	200
64	183	88	56	49	63		58	57	165	125	163	103	131	90	198
68	176	86	56	51	63			56	167		155	251	129		
72	168	83	57	52	63			55	169		119	305	125		
76	163	80	57	54	64			55	173		142	321	125		
80	156	77	58	57	65			55	170		133				
84	151	71						56	167		125				
88	146	68						56	166		115				
92	143	68						57			106				
96	141	65						58			96				
100	138	65													
104															
108															
112															
116															
120															
124															
128															
132															
136															
140															

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	22-1	22-2	22-3	22-4	22 5	22-6	22-7	23-1	23-2	23 3	23-4	25-1	26-1	26-2	26-3
4	323	3856	2568	988	189	17	1316	167	628	388	5160	538	292	252	360
8	414	2160	1776	400	236	32	1376	154	373	154	3096	420	322	172	336
12	381	850	1160	212	245	42	1090	135	360	117	1900	354	288	130	300
16	232	422	826	142	237	45	755	117	320	97	1040	294	243	105	245
20	189	200	680	114	214	44	470	114	288	83	512	266	212	88	204
24	153	89	562	100	192	44	307	114	283	75	226	227	186	78	154
28	124	50	425	82	165	46	218	116	256	69	145	189	161	73	120
32	101	91	283	73	143	48	165	118	231	64	102	169	146	69	104
36	84	87	195	72	127	49	126	117	221	63	83	150	129	66	93
40	74	83	160	72	113	50	102	115	205	62	73	136	114	63	82
44	69	80	145	71	98	51	93	112	193	62	67	121	99	62	75
48	68	75	150	71	84	53	88	108	188	62	63	110	96	62	71
52	66	73		72			81	107	178			99	93	63	68
56	65	70		74			82	105	170			92	94	64	66
60	64	68		74			72	105	160			85	95	65	65
64	62	67		75			75	106	150			86	99	67	65
68	59	65					73	104	141			87	103		64
72	56	63					75	102	133			87			
76	52	60					71	98	128			87			
80	47	54					70	93	121			88			
84	45	5					73		115			89			
88	46	55					68		112						
92	52	58					71		109						
96	64	65					67		105						
100							65		100						
104															
108															
112															
116															
120															
124															
128															
132															
136															
140															

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	26-4	26-5	26-6	26-7	26-8	26-9	26-10	27-1	27-2	27-3	27-4	27-5	27-6	27-7	27-8
4	240	1825	680	142	2084	784	2316	195	2080	241	748	301	62	1000	1428
8	270	577	248	105	1504	719	1392	115	944	141	575	238	69	180	1360
12	205	305	202	80	298	585	570	97	460	133	413	208	41	147	950
16	144	243	176	66	189	278	291	85	280	132	278	190	43	135	621
20	131	214	162	60	148	180	174	69	195	133	227	171	48	131	412
24	92	176	150	57	117	135	118	52	167	135	180	155	55	129	276
28	78	155	143	57	118	114	100	44	143	136	140	143	59	130	201
32	69	134	141	58	105	99	93	41	124	138	103	132	68	130	149
36	64	121	140	61	103	95	93	43	112	141	83	141	70	132	115
40	60	107	138	63	103	93	81	44	102	144	73	140	70	132	105
44	58	99	135	66	103	90	88	46	91	147	70	139	69	135	92
48	57	91	131	69	104	90	91	48	[illegible]	150	71	139	66	133	82
52	56	89	127	73	107	90	82	44	56	153	70	127	70	137	76
56	54	87	124	76	108	91	88	43	58	154	67	124	81	135	77
60	53	67	122	76	112	94	89		59	154	62	113	89	137	72
64	52	92	121	77	115	96	90		58	154	64	74	93	137	67
68		91	121	80	117	101			48	153		90	97	136	69
72		84	121	82	120	105			44	153		77	59	134	65
76		86	121	84	121	110			20	151		90	100	131	62
80		79	120	85	120	113			42	150		94	100	109	
84		72	119	86	120	117			43	149		81	100	108	
88		71	119		123	119			50	148		66	100	108	
92		76	119		126	117			41	146		63	99	108	
96		72	119		124	114			34	145		71	98	107	
100		84	120		120	118			49	142		68	97	110	
104		90	122		129	122				131		65	94	58	
108		81	125		134	126				131		69	92	59	
112		82	129		130	129				132		72	89	60	
116		80				131				128		73	87	62	
120		71				133				125		78	86	61	
124						133				122		75	86	59	
128						136				119		73	86		
132															
136															
140															

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	28-1	28-2	28-3	28-4	28-5	28-6	28-7	28-8	28-9	28-10	28-11	28-12	28-13	29-1	29-2
4	1428	2172	1488	1600	195	256	319	76	2396	212	48	246	2144	480	880
8	1360	2214	528	683	255	67	145	88	598	322	57	240	1392	266	432
12	953	1560	345	493	264	66	139	96	370	324	64	197	980	221	247
16	621	682	267	408	240	107	146	103	240	304	64	154	926	218	195
20	412	576	237	361	214	107	160	113	182	266	59	119	340	218	178
24	276	564	214	334	183	147	150	116	170	230	54	91	220	225	169
28	201	361	196	315	163	134	150	119	156	194	52	76	148	230	148
32	140	111	185	297	147	148	148	120	147	188	51	63	98	225	137
36	118	118	175	297	133	146	143	121	152	176	51	55	73	220	132
40	105	100	166	278	123	144	140	120	146	170	52	47	56	214	129
44	92	162	160	277	120	155	138	121	141	167	51	42	47	209	119
48	82	215	153	265	115	155	125	122	131.	161	50	43	46	205	113
52	76	239	153	262	113	153	114	124	130	153	46	42	50	201	114
56	77	258	154	255	116	147	107	125	154	146	42	40	54	195	112
60	72	179	134	241	113	143	109	125	134	139	38	39	56	189	103
64	67	177	154	225	115	137	111	117	123	134	37	39	57	183	105
68	69	262			116	134	106	128	129	131	36	39	57	177	110
72	66	282			117	134		127	116	126	36	40	56	170	104
76	62	255			118	131		122	109	119	36	41	55	163	97
80		246			119	130		117	104	115		41	53	161	97
84		222			118	130		113	114	110		[illegible]	50	160	102
88		202				126		112	99	104		43	45	157	98
92						124		110	92	100		42	40	150	92
96						126		110	93	99		44	32	142	90
100						118		109	89	93		42	32	134	87
104									89	91		47	33		
108									89	89		46	34		
112									92	88		47	36		
116									86	91		47	35		
120									79	95		52	34		
124									89	90		48	33		
128									83	89		48	32		
132									84	93		49			
136									93	95					
140										98					

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	30-1	31-1	31-2	31-3	32-1	32-2	32-3	32-4	32-5	33-1	33-2	33-3	33-4	34-1	34-2
4	332	908	432	262	1200	992	1740	550	800	228	393	872	186	680	263
8	217	391	191	196	376	1432	760	508	600	116	290	655	180	282	293
12	211	301	197	191	216	276	600	436	470	132	240	520	175	200	308
16	210	294	214	178	187	259	651	382	370	145	203	410	168	146	314
20	192	292	224	200	176	268	590	319	320	155	175	350	162	156	307
24	177	278	233	193	172	257	540	238	284	163	155	308	153	166	278
28	161	277	234	210	167	300	480	213	244	170	144	237	147	175	240
32	148	271	234	218	167	187	426	233	290	174	139	243	138	183	224
36	136	252	229	216	167	181	400	200	290	178	136	290	135	188	211
40	119	244	222	214	166	173	390	200	285	182	133	211	131	190	202
44	114	240	211	228	161	162	400	182	280	185	129	200	130	189	198
48	107	234	200	214	158	160	418	159	275	187	125	187	125	183	186
52	96	225	192	217	149	148	430	156	270	186	120	175	123	177	182
56	87	215	192	219	142	149	430	156	260	183	115	165	121	178	177
60	82	203	192	214	132	139	410	163	250	177	110	160	119	175	172
64	75	197	187	201	125	124	362	156	245	170	104	151	116	154	168
68	67	193	186	196	119	119	350	166	240	165	101	140	115	156	164
72	65	184	156	195	114	118	340	135	226	162	99	130	112	152	160
76	65	174	178	185	112	116	330	133	220	162	98	125	110	151	155
80	64	170	176	172	113	104	318	118	208	163	98	120	108	150	152
84	62	166	172	179	102	84	[illegible]		204	160	97	115	105	150	137
88	58	160	171	184	105	77	300		199	157	96	112	103	150	143
92	54	155	163	167	100		293		194	150	94	110	102	149	138
96	52	155	153	162	96		290		188	142	93	106	98	149	132
100	51	153	143				270			138	92		97	148	127
104							220			133	96		98	139	112
108							200			128	89		99	134	114
112							175			123	99		98	129	119
116							169			120	89		97	126	118
120							160			117	96		96	123	116
124							160			114	90		95	120	114
128							166			110	91		94	117	112
132															
136															
140															

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	34-3	34-4	34-5	34-6	34-7	34-8	34-9	35-1	35-2	35-3	35-4	34-5	35-6	35-7	35-8
4	1327	660	732	630	796	832	1128	174	800	480	792	756	241	215	508
8	1040	414	212	521	188	466	505	198	410	293	238	526	128	236	520
12	762	271	126	360	80	290	505	206	228	243	205	318	104	234	432
16	453	200	112	275	36	152	194	230	197	205	170	206	95	202	288
20	343	163	106	240	25	110	143	256	188	179	130	160	98	160	226
24	249	153	105	210	27	85	119	282	183	160	99	133	105	143	182
28	195	160	101	180	33	68	100	303	181	145	118	118	115	130	155
32	157	145	96	160	38	58	92	320	180	137	116	112	127	120	131
36	125	143	97	150	42	52	84	335	179	132	97	107	136	115	110
40	108	140	84	140	45	48	76	345	177	125	83	102	139	105	92
44	93	138	79	130	47	46	72	351	171	120	84	94	144	100	81
48	75	139	81	122	49	47	79	352	160	114	70	84	145	94	74
52	63	137	71	110	49	48	75	356	140	110	75	78	145	90	
56	66	135	67	108	50	48	75	366	124	108	75	74	144	89	
60	59	130	73	100	52	48	69	370	115	107	70	72	144	88	
64		133	64	92	54	48	64	370	113	106	77	72	143	88	
68		132	64	92	55	49	67	373	117	107		71	143	90	
72		129	67	91	57	52	67	370	125	107		69	143	92	
76		123	62	91	59	57	68	369	129	107		66	142	95	
80		117	60	90	61	63	70	365	132	107		63	139	96	
84			62	89			69	358	133	107		62	122	97	
88			63	88			68	348	133	107		62	110	98	
92			57	90			71	353	132	106		67	80	98	
96			58	97			67	323	130	106		65	56	99	
100			51	90			68	315	127	106		66	50	100	
104				90				302	127	112		65	54	106	
108				95					115	118		66	58	112	
112				88					129	124		68	62	118	
116				93					123	124		69	90	117	
120				95					118	125		70	115	115	
124				99					119	126		71	140	114	
128				99					119	126		73	165	113	
132									125						
136									130						
140									136						

Table A-4. Resistivity Stations

"A" Space	Resistivity Stations														
	35-9	35-10	35-11	35-12	35-13	35-14	36-1	36-2	36-3	36-4	36-5				
4	248	1716	3148	1076	840	119	1784	289	207	2004	652				
8	264	740	2624	1656	1090	69	738	729	133	1496	422				
12	214	502	2484	997	890	72	317	137	114	1272	230				
16	170	427	1104	866	762	72	190	100	114	979	160				
20	143	336	910	738	680	74	148	90	118	800	131				
24	124	298	922	636	612	81	128	86	120	638	127				
28	113	273	680	557	565	86	114	70	122	630	130				
32	110	243	486	483	528	92	101	70	121	528	136				
36	112	212	536	436	485	88	92	72	123	436	141				
40	116	198	294	384	452	88	85	76	120	379	144				
44	120	182	241	352	425	88	82	80	117	314	148				
48	125	175	239	325	400	87	79		115	253	148				
52	127	163	281	304	373	88	76		115	240	149				
56	125	155	251	283	343	87	72		114	214	149				
60	123	147	268	268	325	90	66		113	184	149				
64	122	140	285	255	305	90	65		113		149				
68	125	134	298	241	295	90	67		113		148				
72	130	126	299	225	280	90	71		113		148				
76	138	130	48	213	268		76		112		148				
80	148	131	274	205	255		79		111		148				
84	150	135	34	202	245		79		109		148				
88	145	138		195	232		77		111		145				
92	138	120		190	223		76		114		143				
96	134	108		185	211		76		116		140				
100	134	139		181	105		77		117		138				
104	133	123			194										
108	134	136			190										
112	134	141			187										
116	132	144													
120	132	133													
124	130	154													
128	128														
132															
136															
140															

Table A-5 LITHOLOGIC LOGS

Table A-5. LITHOLOGIC LOGS

Formation Description	Thickness	Depth

TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN

2bbd1-Observation well drilled under this project. Cased to 45 feet with 1¼ inch galvanized steel pipe, 3 foot well point, and gravel packed. Water sample analyzed; electric log also available. Estimated mean sea level elevations: Land Surface 1012 feet; Bedrock 967 feet.

Brown sandy soil	2	2
Sand, brown, thin streak of coarse sand	6	8
Clay, light gray, brown sandy clay	4	12
Sand, brown to red, med to fine	8	20
Sand, brown, med to very fine	12	32
Sand, brown, med to coarse	8	40
Sand, brown, very coarse, fine gravel	5	45
Permian Bedrock, clay, red		

2cac1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Estimated mean sea level elevation: Land Surface 998 feet; Bedrock 967 feet.

Soil, sandy, brown	2	2
Silt, red brown to brown	3	5
Clay, light gray and red brown silty clay	11	16
Permian Bedrock, clay, red	4	

3abb1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1011 feet; Bedrock 971 feet.

Sand, fine to med, reddish brown	13	13
Clay, reddish brown	7	20
Clay, reddish brown and gray	5	25
Clay, gray	8	33
Sand, very coarse; gravel	7	40
Permian Bedrock, siltstone, red	4	

3abb2-Observation well developed under this project. Cased with 41 feet of 4½ inch PVC well casing, slotted and gravel packed. Water sample analyzed, electric log available. Estimated mean sea level elevations: Land Surface 1015 feet; Bedrock 975 feet.

Brown sandy soil	2	2
Sand, red brown, fine	11	13

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
3abb2-continued		
Clay, red brown, sandy	8	21
Clay, light gray and light brown	10	31
Sand, med to very coarse, some gravel	9	40
Permian Bedrock, clay, red	2	
3bba1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1028 feet; Bedrock 959 feet.		
Sand, fine, brown	9	9
Clay, light brown, silty	12	21
Sand, fine, reddish brown	16	37
Clay, brown to gray	17	54
Sand, coarse to very coarse, gravel	15	69
Permian Bedrock, siltstone, red	1	
3bbb1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1030 feet; Bedrock 970 feet.		
Sand, fine, light brown to red brown	5	5
Silt, light red brown, clayey	5	10
Sand, fine to very fine, light red brown	13	23
Clay, red brown to light gray (caliche like) hard	2	25
Sand, very fine, light red brown	6	31
Clay, reddish brown	7	38
Sand, fine, reddish brown	2	40
Sand, med to coarse	10	50
Sand, very coarse, fine gravel	10	60
Permian Bedrock, clay and siltstone, red	1	
3bcc1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1027 feet; Bedrock 976 feet.		
Sand, fine to very fine, brown	10	10
Sand, fine to very fine, red brown and red brown clay	5	15
Sand, fine to very fine and silty red brown to brown	10	25

Table A-5 (continued). LITHOLOGIC LOGS

TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN

3bcc1-continued

Formation Description	Thickness	Depth
Sand, fine to very fine, red brown to brown	5	30
Sand, fine to very fine, clayey, red brown to brown	5	35
Clay, red brown, sandy	4	39
Sand, med to coarse, brown some fine gravel	6	45
Sand, fine to coarse, brown	6	51
Permian Bedrock, clay, red	2	

3cdc1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1013 feet; Bedrock 976 feet.

Formation Description	Thickness	Depth
Silt, brown, clayey	5	5
Silt, brown	5	10
Silt, red brown, to brown, clayey	5	15
Silt, light red brown	5	20
Sand, med to very fine, brown	7	27
Sand, coarse to very coarse	10	37
Permian Bedrock, clay and siltstone, red	3	

3dac1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1005 feet; Bedrock 988 feet.

Formation Description	Thickness	Depth
Silt, red brown to brown top foot sandy soil	5	5
Silt, red brown to brown	7	12
Sand, med to very coarse, brown	5	17
Permian Bedrock, shale, red	3	

4baa1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1048 feet; Bedrock 988 feet.

Formation Description	Thickness	Depth
Soil, soft brown clayey sand	2	2
Clay, gray	7	9
Sand, fine to med, brown, thin streaks of yellow to brown clay	11	20
Silt, fine sand, reddish brown	5	25

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
4baa1-continued		
Sand, fine, silty, light brown	11	36
Sand, fine to med, light brown	4	40
Sand, fine, light brown	16	56
Sand, coarse	4	60
Permian Bedrock, redbeds	5	
4ddc1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1020 feet; Bedrock 978 feet.		
Sand, very fine, silty brown	5	5
Sand, very fine, some clay, brown	5	10
Sand, very fine, brown to red brown	10	20
Sand, very fine, brown to lt. red brown	10	30
Sand, med to very coarse, brown, some gravel	12	42
Permian Bedrock, shale, red	3	
5cca1-Irrigation well developed in Cimarron Terrace. Information from water rights file of Earl Wilson. Estimated mean sea level elevations: Land Surface 1009 feet; Bedrock 984 feet.		
Top soil, sandy loam	3	3
Clay, subsoil	2	5
Sand, fine	3	8
Sand, water bearing	8	16
Gravel, coarse	4	20
Clay, tan	1	21
Gravel, coarse	4	25
Permian Bedrock, redbeds		
5bab1-Irrigation well developed in Cimarron Terrace. Information from water rights file of Charles Wilson. Estimated mean sea level elevations: Land Surface 1005 feet; Bedrock 921 feet.		
Top soil and sand, fine	12	12
Sand, fine with thin clay layers	18	30
Sand, med, with flakes of shale	42	72
Sand, very coarse	12	84
Permian Bedrock, redbeds		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 16 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
6aac1-Irrigation well developed in Cimarron Terrace. Information from water rights file of Harry Wilson. Estimated mean sea level elevations: Land Surface 1026 feet; Bedrock 988 feet.		
Top soil	2	2
Clay	6	8
Clay, fine, sandy	11	19
Sand, fine	7	26
Clay	0.5	26.5
Sand, coarse	11.5	38
Permian Bedrock, shale	3	
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
6ccc1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1162 feet; Bedrock 1115 feet.		
Sand, fine, brown to yellow	3	0
Clay, gray, sandy	2	3
Clay, gray, sandy, reddish brown, fine sand	5	5
Sand, fine to very fine, reddish brown	37	10
Permian Bedrock, clay, red, brick red and maroon	13	
14dcc1-Test well drilled under this project. Drilled for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1116 feet; Bedrock 973 feet.		
Sand, fine, brown to reddish brown	5	5
Sand, fine, brown	15	20
Sand, fine to very fine, clayey, brown	12	32
Clay, gray	6	38
Clay, reddish brown	5	43
Permian Bedrock, clay, red	2	
14ddd1-Test hole drilled under this project. Drilled for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1100 feet; Bedrock 967 feet.		
Road fill, sandy clay, brown and red	2	2
Sand, fine, silty, yellow brown	3	5

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
14dddl-continued		
Sand, fine, brown	8	13
Clay, gray to tan	5	18
Clay, brown to reddish brown	13	31
Permian Bedrock, clay, red	1	
16dccl-Test hole drilled under this project. Drilled for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1115 feet; Bedrock 1050 feet.		
Sand, brown, fine	1	1
Sand, brown to reddish brown, fine	9	15
Clay, gray brown	6	16
Sand, fine, reddish brown	4	20
Sand, fine, red to brown	5	25
Silt, brown to red brown, clayey	13	38
Sand, fine to very fine, red brown	27	65
Permian Bedrock, clay, red	5	
16dddl-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1109 feet; Bedrock 1077 feet.		
Sand, fine, brown	5	5
Clay, reddish brown, to brown, some light gray color	6	11
Clay, reddish brown, silty	9	20
Clay, brown to red brown	12	32
Permian Bedrock, clay, red	3	
19aaal-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1092 feet; Bedrock 1008 feet.		
Sand, brown to tan, fine	3	3
Sand, silty, some clay, brown to tan	2	5
Sand, fine to very fine, brown to red brown	23	28
Sand, fine to very fine, some silt and red and gray clay	9	37

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
19aaa1-continued		
Sand, fine to very fine, silty red brown	6	43
Sand, very fine to silty, red, some clay	3	46
Sand, very fine, red to red brown	19	65
Clay, brown, fine sand	5	70
Clay, brown to gray, some coarse sand	5	75
Sand, very coarse, some small gravel Thin clay layer at 75' possibly ½" thick	5	80
Sand, very coarse, some small gravel	4	84
Permian Bedrock, siltstone and shale, red	3	
19aad-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea leval elevations: Land Surface 1090 feet; Bedrock 1002 feet.		
Sand, fine, light brown	5	5
Sand, fine, buff to tan	5	10
Sand, very fine, reddish brown	11	21
Clay, gray and reddish-brown, sandy, carbonaceous	8	29
Sand, fine, light reddish brown	6	35
Sand, fine, buff to tan	6	41
Clay, light buff brown, silty	3	44
Sand, fine to very fine, reddish brown, carbon	16	60
Clay, light brown, tough	3	63
Clay, red to reddish brown	14	77
Sand, very coarse, fine gravel	11	88
Permian Bedrock, shale, red to brick red	1	
19add-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1080 feet; Bedrock 999 feet.		
Sand, fine, light brown to tan, some brown clay	5	5
Sand, fine, reddish brown	10	15
Sand, fine, tan to light brown	10	25
Sand, very fine, brown, thin layers brown clay	5	30
Sand, very fine, tan to gray, silty	5	35
Sand, very fine, tan to light brown to red brown	15	50

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
19add-continued		
Sand, very fine, reddish brown to tan, carbon particles	12	62
Clay, red, gummy	7	69
Sand, coarse to fine, brown	12	81
Permian Bedrock, shale, red to brick red, hard	1	
19dad-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surfaces 1077 feet; Bedrock 1000 feet.		
Sand, fine, brown	4	4
Clay, dark gray, light gray on bottom	5	9
Sand, fine, light gray	8	17
Sand, fine, light gray, gray clay streaks	8	25
Sand, very fine, silty, light gray	16	41
Clay, light gray	9	50
Sand, fine to med, light gray to light brown	15	65
Sand, fine to coarse, light gray to brown	5	70
Sand, very coarse	6	76
Permian Bedrock, shale, red to brick red	1	
19dcc-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1073 feet; Bedrock 997 feet.		
Sand, fine yellow to brown, silty	5	5
Sand, fine, light brown, yellow-brown clay	5	10
Sand, fine to very fine, tan	5	15
Sand, fine to very fine, reddish brown, carbon	17	32
Clay, reddish brown, sandy	11	43
Sand, fine, light brown to red brown	2	45
Clay, gray, some sand, soft	10	55
Sand, fine, tan to buff	3	58
Clay, gray, yellow, light brown, some sand	6	64
Sand, coarse to fine, some fine gravel	12	76
Permian Bedrock, shale, red to brick red	1	

Table A-5 (continued). LITHOLOGIC LOGS

TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN

19ddc1-Test hole drilled under this project for lithologic purposes, no casin installed. Electric log available. Estimated mean sea level elevations: Land Surface 1079 feet; Bedrock 1001 feet.

Formation Description	Thickness	Depth
Sand, fine, brown to tan	7	7
Clay, gray, silty	3	10
Sand, fine, gray, some clay	5	15
Sand, fine, tan to light brown	25	40
Clay, light gray, silty	13	53
Sand, fine brown	7	60
Sand, fine, brown, thin streaks of gray and red clay	5	65
Sand, coarse, brown streaks of gray and red clay	5	70
Sand, coarse, fine gravel	8	78
Permian Bedrock, siltstone, red	2	

20bdb1-Irrigation well developed in the Cimarron Terrace. Information from water rights file of Norman Shutler. Estimated mean sea level elevations: Land Surface 1090 feet; Bedrock 978 feet.

Top soil	3	3
Sand, fine	17	20
Clay	10	30
Sand, fine	12	42
Clay	7	49
Clay, fine, sandy	11	60
Clay	1	61
Sand, fine	11	72
Clay	3	75
Sand, med to coarse	6	81
Sand, coarse, clean	11	92
Permian Bedrock, redbeds	2	

21ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1051 feet; Bedrock 989 feet.

Sand, fine to medium, tan to gray	5	5
Sand, fine to med, tan, some silty clay streaks	12	17
Sand, fine tan	4	21
Silt, some fine sand, tan	10	31

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
21ccc1-continued		
Sand, fine, tan to reddish brown	9	40
Sand, coarse to very coarse, tan	15	55
Sand, coarse to very coarse, tan to yellow	7	62
Permian Bedrock, siltstone, hard	3	
21ccc2-Crescent City well Number 1 developed in Cimarron Terrace. Information from water rights file. Estimated mean sea level elevations: Land Surface 1058 feet; Bedrock 990 feet.		
Sand, light brown	20	20
Sand, fine, brown (quick sand)	28	48
Gravel, coarse, water	20	68
Permian Bedrock, siltstone	3	
21cdc1-Crescent City well Number 2 developed in Cimarron Terrace. Information from water rights file. Estimated mean sea level elevations: Land Surface 1056 feet; Bedrock 968 feet.		
Sand, light brown	30	30
Sand, brown	35	65
Gravel, coarse	25	90
Permian Bedrock, shale, red	3	
22aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1137 feet; Bedrock 1095 feet.		
Earth fill material, sandy clay	1	1
Silt, brown, clayey	5	6
Sand, fine, yellow clay	4	10
Sand, fine, silty, reddish brown	6	16
Clay, reddish brown	4	20
Silt, reddish brown	4	24
Clay, reddish brown, silty	6	30
Silt, reddish brown	12	42
Permian Bedrock, clay, red	3	
22daa1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1130 feet; Bedrock 1059 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
22daa1-continued		
Sand, fine, brown	5	5
Sand, fine, tan to red brown light	15	20
Sand, fine, light brown	17	37
Clay, gray and brown	5	42
Sand, brown to reddish brown, silty	18	60
Clay, red brown and yellow, sandy	5	65
Sand, very fine, reddish brown	6	71
Permian Bedrock, siltstone, red	4	
23ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1112 feet; Bedrock 1051 feet.		
Sand, fine, brown	10	10
Sand, fine, yellowish brown to tan	10	20
Some clay about 19' (Maybe dry silt)		
Sand, fine, light brown to reddish brown	5	25
Sand, fine, brown, silty	10	35
Sand, fine, silty, brown with gray streaks	15	50
Sand, fine brown	11	61
Permian Bedrock, clay, red	4	
25baa1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1083 feet; Bedrock 1057 feet.		
Sand, fine, brown to reddish brown	11	11
Silt, brown, clayey	2	13
Sand, fine, brown	7	20
Sand, fine, brown, carbon	6	26
Permian Bedrock, clay, red	9	
26aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1055 feet; Bedrock 1035 feet.		
Sand, fine, brown	5	5
Sand, fine, silty, brown to reddish brown	5	10
Sand, fine, silty to clayey, reddish brown	6	16

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
26aaa1-continued		
Clay, gray, sand, reddish brown	4	20
Permian Bedrock, clay, red	4	
26abb1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric logs available. Estimated mean sea level elevations: Land Surface 1078 feet; Bedrock 1056 feet.		
Sand, fine, reddish brown	11	11
Clay, brown to reddish brown	11	22
Permian Bedrock, clay, red	3	
27add1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric logs available. Estimated mean sea level elevations: Land Surface 1060 feet; Bedrock 1015 feet.		
Sand, fine brown	4	4
Clay, brown	1	5
Sand, fine, brown	7	12
Permian Bedrock, clay, reddish brown, firm and red, siltstone, red	33	45
27bba1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1100 feet; Bedrock 1060 feet.		
Soil, sandy brown	1	1
Silt, brown, clayey	7	8
Sand, fine, brown	2	10
Sand, reddish brown, fine	6	16
Silt, reddish brown,clayey	10	26
Clay, gray, slightly silty	4	30
Clay, gray and reddish brown, silty	6	36
Clay, reddish brown (tough to drill)	4	40
Permian Bedrock, clay, red, tough	14	
27cbb1-Test hole drilled under this project for lithologic purposes, 48 feet of 4½ inch PVC well casing slotted, and gravel packed. Electric log available. Estimated mean sea level elevations: Land Surface 1036 feet; Bedrock 992 feet; Water Table 1026.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
27cbb1-continued		
Sand, very fine, brown	5	5
Sand, fine, light brown	5	10
Sand, fine to silty, some small amount of clay	5	15
Sand, very fine, brown to gray brown	5	20
Clay, gray	9	29
Sand, fine to coarse, gray to brown some small gravel	15	44
Permian Bedrock, shale and siltstone, red	6	
27cdc1-Observation well developed under this project for water level data and water quality data. Well cased to 34 feet with 4½ inch ID in PVC well casing, slotted with gravel pack. Water analysis available. Estimated mean seal level elevations: Land Surface 1024 feet; Bedrock 978 feet; Water Table 1014 feet.		
Sand, med to fine, light brown	5	5
Sand, med, brown to light brown	5	10
Sand, fine to coarse, light brown, thin layer of clay about 17'	10	20
Sand, med to coarse, tan, clean	5	25
Sand, coarse to very coarse, yellow to brown, gravel	8	33
Permian Bedrock, clay, red	1	
28aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1060 feet; Bedrock 1000 feet.		
Sand, fine, brown	2	2
Clay, gray	6	8
Sand, fine, brown to yellow or tan	14	22
Clay, gray, light, sandy, yellowish brown	6	28
Sand, fine, brown streaks of silty clay, gray	12	40
Silty, red to reddish brown, soft drilling some clay	20	60
Permian Bedrock, siltstone, red, hard drilling	5	

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
28abbl-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1068 feet; Bedrock 991 feet.		
Sand, brown, fine	7	7
Silt, fine, sand, brown, clayey	8	15
Silt, fine, sand, brown to gray	5	20
Silt, brown, clayey	16	36
Silt, clayey, reddish brown, soft	4	40
Sand, fine to very fine, brown to red-brown	14	54
Clay, gray, tought to drill	3	57
Clay, silty, gray to brown	5	62
Sand, coarse to very coarse	15	77
Permian Bedrock, clay	3	
28cccl-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1048 feet; Bedrock 990 feet.		
Sand, fine brown	5	5
Sand, fine to silty, red brown to brown	10	15
Silt, brown, very fine sand, some brown clay	13	28
Clay, light gray, some red brown clay	6	34
Sand, fine to coarse, yellow brown, some fine gravels	6	40
Sand, med to very coarse, brown, fine gravels, clean	18	58
Permian Bedrock, clay, red	2	
28cddl-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1032 feet; Bedrock 992 feet.		
Sand, silty, brown to gray	5	5
Sand, silty, brown	10	15
Sand, silty, brown clay about 19'	5	20
Clay, gray, sandy	4	24
Sand, coarse to very coarse, some gravel	16	40
Permian Bedrock, redbed	4	

Table A-5 (continued). LITHOLOGIC LOGS

TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN

29bcc-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1063 feet; Bedrock 998 feet.

Formation Description	Thickness	Depth
Sand, fine to med, tan to light brown	5	5
Sand, very fine, light red brown	5	10
Sand, fine, tan to red, carbon flakes	29	39
Clay, reddish brown soft	5	44
Sand, coarse, light brown to reddish brown	6	50
Sand, coarse, yellow	5	55
Sand, very coarse, fine gravel, tan	9	64
Permian Bedrock, shale, red to maroon, hard	1	

29cac1-Irrigation well developed in Cimarron Terrace. Information for water rights file of Lea Mize. Estimated mean sea level elevations: Land Surface 1058 feet; Bedrock 987 feet.

Formation Description	Thickness	Depth
Sandy loam	3	3
Clay	9	12
Sand, fine	5	17
Sand, fine to med	26	43
Sand, coarse, well sorted, clean	28	71
Permian Bedrock, redbeds	1	

29daa1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1062 feet; Bedrock 995 feet.

Formation Description	Thickness	Depth
Sand, very fine, brown	5	5
Sand, very fine, light brown	5	10
Sand, very fine, red brown	6	16
Clay, red brown, some sand, fine	4	20
Sand, very fine to silty, red brown	18	38
Clay, red brown	2	40
Sand, fine to coarse, yellow to brown	10	50
Sand, med to coarse, brown, fine gravel	17	67
Permian Bedrock, shale, red	3	

29dc1-Irrigation well developed in Cimarron Terrace. Information from water rights file of Jerry Johnson. Estimated mean sea level elevations: Land Surface 1061 feet; Bedrock 985 feet.

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
29dc1-continued		
Soil, sandy	3	3
Sand	15	18
Clay	6	24
Sand	12	36
Clay, sandy	20	56
Sand, coarse clean	22	78
Permian Bedrock, redbeds	2	
31abal-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1059 feet; Bedrock 995 feet.		
Sand, fine, tan	3	3
Clay, light brown, sandy	2	5
Sand, fine, light brown to reddish brown	8	13
Clay, light gray, yellow, light brown, sandy	4	17
Sand, fine to very fine, tan to light brown, carbon flakes	32	51
Clay, reddish brown, sandy	2	53
Sand, fine reddish brown	4	57
Sand, fine to coarse, light brown	7	64
Permian Bedrock, shale, red to maroon	1	
31add2-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1056 feet; Bedrock 981 feet.		
Sand, fine, brown to light brown	5	5
Sand, fine to very fine, light brown, yellow, red, reddish brown, some carbon	32	37
Clay, brown and gray	3	40
Clay, gray to light yellow gray, some gravel and shell fragments	15	55
Clay, light gray and reddish brown	5	60
Sand, very coarse, and fine gravel, tan to light brown	14	74
Permian Bedrock, shale, red to maroon, hard	1	

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
31bba1-Irrigation well developed in Cimarron Terrace. Information from water rights file of Cecil Schnelen. Estimated mean sea level elevations: Land Surface 1060 feet; Bedrock 979 feet.		
Top soil	2	2
Sand, red	13	15
Clay	5	20
Clay, sandy	9	29
Sand, red	13	42
Clay	13	55
Sand, coarse	5	60
Sand, coarse, clean	21	81
Permian Bedrock, shale	2	
31ccc1-Test hole drilled under this project for lithologic purposes, well developed with 52 feet of 4½ inch PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1045 feet; Bedrock 995 feet; Water Table 1021 feet.		
Sand, med to very fine, light brown, buff and tan	15	15
Sand, med to fine, light red brown, carbon flakes	5	20
Sand, fine, red brown	12	32
Clay, brown, light gray brown, silty, soft	2	34
Sand, fine to very fine, light brown to red brown	6	40
Sand, fine light brown	4	44
Sand, med to coarse, light brown	6	50
Permian Bedrock, siltstone, red to maroon, gray streaks	4	
32bbb1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1061 feet; Bedrock 991 feet.		
Sand, fine, light brown	10	10
Sand, fine to med, light brown	5	15
Sand, fine to med, reddish brown, thin clay streaks	12	27
Clay, reddish brown	2	29
Sand fine to very fine, reddish brown	16	45

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
32bbb1-continued		
Clay, brown to reddish brown	12	57
Sand, very fine	6	63
Sand, coarse to very coarse	7	70
Permian Bedrock, siltstone, red	5	
32dcc1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1050 feet; Bedrock 986 feet.		
Sand, fine, reddish brown, to brown	30	30
Sand, fine, reddish brown, thin streaks clay	5	35
Sand, fine, reddish brown	5	40
Sand, fine, reddish brown, clay at 57'	17	57
Clay, brown	3	60
Sand, med	4	64
Permian Bedrock, redbeds	3	
21cbb1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1080 feet; Bedrock 991 feet.		
Sand, fine to very fine, gray to tan	10	10
Sand, fine to very fine, brown to red brown	15	25
Sand, fine to very fine, black particles	10	35
Sand, very fine, red brown	30	65
Clay, red brown to brown	7	72
Sand, coarse to very coarse, fine gravel	17	89
Permian Bedrock, siltstone, red	6	
33aab1-Observation well developed under this project, cased to 64 feet with 1¼ inch galvanized steel well point and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1058 feet; Bedrock 993 feet; Water Table 1023 feet.		
Sand, fine to med, light brown	5	5
Sand, fine to very fine, light brown to tan	5	10
Sand, fine to very fine, red brown, silty	10	20

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
33aabl-continued		
Sand, fine to very fine, reddish brown	6	26
Clay, reddish brown and gray	16	42
Sand, fine, light brown	3	45
Sand, med to very coarse, light brown	20	65
Permian Bedrock, clay, red		
33cbbl-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1054 feet; Bedrock 977 feet.		
Sand, very fine, red brown	6	6
Silt to very fine sand, red brown to brown	16	22
Clay, brown, silty	9	31
Sand, med to fine, brown	5	36
Clay, gray and brown	6	42
Sand, fine, brown, intermixed with brown clay	9	51
Sand, fine to coarse, brown	4	55
Sand, med to coarse, brown	22	77
Permian Bedrock, shale, red	3	
33cccl-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1050 feet; Bedrock 994 feet.		
Sand, fine, brown, clean	5	5
Sand, fine to very fine, light brown, to brown	10	15
Sand, fine to very fine, red brown; black carbon material	15	30
Sand, very fine, red brown to brown; thin clay lenses	12	42
Sand, med to very coarse, brown	14	56
Permian Bedrock, shale, red	2	
33ccd-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1000 feet; Bedrock 967 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
33ccd-continued		
Sand, fine to med, black to dark gray and light brown, few coarse sand pebbles	5	5
Sand, fine to very fine, light brown to tan	10	15
Clay, dark gray	1	16
Sand, fine to very fine, light brown, carbonaceous	4	20
Clay, dark gray, gummy	10	30
Sand, med to coarse, brown	3	33
Permian Bedrock, shale, red to brick red	4	
33dbb-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1060 feet; Bedrock 983 feet.		
Sand, fine to very fine, brown, light brown	20	20
Sand, fine to very fine, reddish brown, carbon	17	37
Clay, reddish brown, yellow, tan, sandy	6	43
Sand, fine reddish brown, some clay	12	55
Sand, fine to med, light brown	6	61
Sand, fine to very fine, streaks of red, uellow, and brown clay	9	70
Clay, red, reddish brown and yellow	5	75
Sand, coarse, tan to brown to red brown	2	77
Permian Bedrock, shale, red, dark red, maroon, white, hard	3	
33dda-Observation well developed in Cimarron Terrace for water level data and water quality data. Well developed with 83 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1045 feet; Bedrock 965 feet.		
Sand, fine, light brown	6	6
Clay, light brown, sandy	4	10
Sand, fine to very fine, light brown	11	21
Clay, reddish brown, sandy	9	30
Sand, very fine, reddish brown	5	35
Clay, reddish brown, silty and fine sand	20	55
Clay, light brown, silty	12	67
Sand, coarse, brown to tan	3	70

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
33dda-continued		
Sand, very coarse, fine gravel, light brown	10	80
Permian Bedrock, siltstone, red, maroon, white, hard	5	
34aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1048 feet; Bedrock 982 feet.		
Sand, fine, brown to reddish brown	5	5
Sand, brown to reddish brown, clayey	5	10
Sand, fine, brown to reddish brown	5	15
Sand, tan to gray, fine to silty, clayey	5	20
Sand, fine to very fine, tan to brown	5	25
Sand, fine to very fine, tan to brown, clay streak	5	30
Silt, tan to brown, clayey	15	45
Sand, coarse, clean, fine gravel	15	60
Sand, very coarse	6	66
Permian Bedrock, siltstone	5	
34aab1-Test hole drilled under this project for lithologic purposes. Test hole converted to observation well by installing 74 feet of 1¼ inch steel pipe with sand point and gravel packed. Estimated mean sea level elevations: Land Surface 1058 feet; Bedrock 984 feet; Water Table 1027 feet.		
Sand, fine, brown	5	5
Sand, fine, light brown	3	8
Clay, red brown, brown, sandy	12	20
Sand, fine to med, light brown to red, clayey silt	11	31
Clay, red brown, silty	16	47
Sand, fine, light brown	3	50
Sand, med to coarse, some fine gravel	10	60
Sand, very coarse, some gravel	4	64
Clay, yellow	1	65
Sand, very coarse to fine	9	74
Permian Bedrock, clay and siltstone, red	1	
34abb1-Observation well developed under this project for water level data and water quality data. Well cased to 60 feet with 4½ inch ID in PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1045 feet; Bedrock 989 feet; Water Level 1011 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
34abb1-continued		
Sand, fine to med, brown	5	5
Sand, med, light brown	5	10
Sand, med to fine, silty, light brown to red brown	10	20
Sand, fine, silty, red to brown some clay	5	25
Clay, red brown to gray	13	38
Sand, med to coarse, brown to tan	2	40
Sand, coarse to very coarse, fine gravel, yellow brown	16	56
Permian Bedrock, siltstone	1	
34add1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1030 feet; Bedrock 974 feet.		
Sand, brown, fine	5	5
Sand, fine, red to brown	11	16
Clay, reddish brown and brown	12	28
Sand, med to coarse, brown	7	35
Sand, very coarse	15	50
Sand, very coarse, some gravel	6	56
Permian Bedrock, siltstone, red to varigated	4	
34bab1-Test hole drilled under this project for lithologic purposes. Converted to observation well, installed 43 feet of 1¼ inch steel casing with well point, gravel packed. Electric log available. Estimated mean sea level elevations: Land Surface 1023 feet; Bedrock 980 feet; Water Table 1019 feet.		
Sand, brown, fine	5	5
Sand, brown, fine, some silt and clay	5	10
Sand, brown, fine	5	15
Sand, very fine to silt, some clay	5	20
Sand, tan, med to fine, clean	5	25
Sand, tan, med to coarse	5	30
Sand, brown, very coarse	5	35
Sand, brown, very coarse to fine gravel	8	43
Permian Bedrock, redbeds	2	

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
34bbb1-Test hole drilled under this project for lithologic purposes, installed 63 feet of 1¼ inch steel casing with well point for water level and water quality data. Electric log and water analysis available. Estimated mean sea level elevations: Land Surface 1052 feet; Bedrock 990 feet; Water Table 1021 feet.		
Sand, fine, brown, clay about 4'	5	5
Silt, fine sand	5	10
Silt, brown	5	15
Silt, brown to gray	8	23
Sand, fine, brown	4	27
Silt, reddish brown, clayey	13	40
Sand, fine to med, clean	5	45
Sand, med to very coarse, clean	5	50
Sand, med to very coarse, clean, fine gravel	5	55
Sand, yellow to brown, very coarse	7	62
Permian Bedrock, redbed	3	
34bdd-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1010 feet; Bedrock 977 feet.		
Sand, very fine, brown light, brown and red	5	5
Sand, very fine, light brown	7	12
Clay, light reddish brown, sand fine to coarse	3	15
Sand, fine to coarse, light red brown	5	20
Sand, med to very coarse, some fine gravels	5	25
Sand, coarse, fine gravel	8	33
Permian Bedrock, clay, red to brick red, yellow gray	2	
34cbb1-Test hole drilled under this project for lithologic purposes, no casing installed. Electric log available. Estimated mean sea level elevations: Land Surface 1050 feet; Bedrock 987 feet.		
Sand, fine to very fine, brown to red brown	5	5
Sand, very fine, to silty, red brown to brown	33	38

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
34cbb1-continued		
Sand, very fine, red brown to brown, clayey	2	40
Sand, very fine, to silty, brown to red brown	10	50
Sand, med to coarse, brown	5	55
Sand, med to very coarse, brown	8	63
Permian Bedrock, shale, red	2	
34ccb1-Observation well developed under this project, in Cimarron Terrace for water level and water quality data. Water quality analysis available. Installed 69 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1050 feet; Bedrock 979 feet; Water Table 998 feet.		
Sand, med to fine, red brown	5	5
Sand, med, red brown to brown	10	15
Sand, fine, light brown to tan	6	21
Sand, fine to silty, some clay red brown	13	34
Sand, fine to silty, red brown	13	47
Clay, red brown, silty	4	51
Sand, red brown, very fine to silty	5	56
Clay, red brown to brown, silty	9	65
Sand, med to coarse, brown to red brown	6	71
Permian Redbeds, clay, red to maroon	1	
34cdc1-Observation well developed under this project for water level and water quality data. Water quality analysis available. Well cased with 55 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1028 feet; Bedrock 974 feet; Water Table 1000 feet.		
Sand, dark brown, sandy	4	4
Clay, red brown, sandy	15	19
Sand, med to fine, brown to red	11	30
Clay, brown to red	12	42
Sand, brown, med to coarse, fine gravel	12	54
Permian bedrock, clay, red	1	
34dcc1-Observation well developed under this project for water level and water quality data. Cased with 20 feet of 1¼ inch galvanized steel well casing, and well point and gravel		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
34dcc1-continued		
packed. Water analysis available. Estimated mean sea level elevations: Land Surface 990 feet; Bedrock 970 feet; Water Table 984 feet.		
Sand, brown, fine	5	5
Clay, light brown to gray	8	13
Sand, coarse to very coarse, some gravel	7	20
Permian Bedrock, clay	1	
35ccd1-Test hole drilled under this project for lithologic purposes. Estimated mean sea level elevations: Land Surface 1000 feet; Bedrock 979 feet.		
Sand, medium light brown, clean	5	5
Sand, medium to fine, brown	5	10
Sand, medium to coarse, gray to brown	5	15
Sand, very coarse, fine gravels, brown	6	21
Permian Bedrock, siltstone	4	
35dcd1-Test hole drilled under this project for lithologic purposes. Electric log available. Estimated mean sea level elevations: Land Surface 1040 feet; Bedrock 967 feet.		
Soil	1	1
Sand, fine to medium, reddish brown to brown	4	5
Sand, fine to medium, brown	16	21
Sand, red, clay streaks, brown to red brown	3	24
Clay reddish brown, some sand	6	30
Clay, brown to light gray	9	39
Sand, reddish brown, clay streaks	6	45
Clay, red brown and gray	8	53
Sand, med to coarse, brown	20	73
Permian Bedrock, clay	2	
36bba1-Test hole drilled under this project for lithologic purposes. Estimated mean sea level elevations: Land Surface 1050 feet; Bedrock 1020 feet.		
Sand, reddish brown, fine	5	5
Sand, reddish brown to brown, clayey	5	10
Sand, very fine, brown	5	15

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
36bba1-continued		
Clay, red to brown	3	18
Clay, red, sandy	7	25
Permian Bedrock, clay, red	15	
36cdc1-Test hole drilled under this project for lithologic purposes. Estimated mean sea level elevations: Land Surface 1018 feet; Bedrock 972 feet.		
Sand, brown, clay top 2' fill	5	5
Sand, reddish brown to brown, fine	41	46
Permian Bedrock, siltstone		
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN		
4bbb1-Test hole drilled under this project for lithologic purposes. Converted to well with 95 feet of 4½ inch PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1130 feet; Bedrock 1031 feet; Water Table 1107 feet.		
Sand, brown, fine to med	5	5
Sand, light brown to yellow, fine to med	10	15
Sand, reddish brown, fine to med	10	25
Sand, buff, med to very fine, some silt and tin clay lens	5	30
Sand, brown, med to very fine, carbonaceous	5	35
Sand, brown to reddish brown, fine to very fine, silty, some clay lenses	25	60
Clay, red brown, silty	25	85
Clay, dark gray, some gravel near 95	10	95
Clay, dark gray; fine gravel, shell fragments	5	100
Clay, red brown	2	102
Permian Bedrock, clay, red to maroon		
6bba1-Test hole drilled under this project for lithologic purposes. Converted to observation well with 66 feet of 4½ inch PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1146 feet; Bedrock 1079 feet; Water Table 1112 feet.		
Sand, fine to med, brown, few pebbles of very coarse sand	5	5

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN		
6bba1-continued		
Sand, fine to very fine, brown to light brown and tan brown clay streaks	10	15
Sand, fine to very fine, tan some gray clay	5	20
Sand, very fine, tan, gray and reddish brown, some clay and silt	5	25
Clay, tan, red, reddish brown, fine very fine sand	15	40
Clay, red to reddish brown, soft	20	60
Sand, very fine to med, tan to light brown	7	67
Permian Bedrock, shale, red to maroon	5	
8ddd1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1089 feet; Bedrock 1019 feet.		
Sand, fine light brown, brown and red brown	10	10
Sand, fine, light brown, some light gray brown clay	5	15
Clay, red brown, sandy	5	20
Clay, red brown, yellow, gray, sandy	5	25
Sand, med to fine, silt, red brown, some red clay	15	40
Sand, fine to very fine, red brown to tan	5	45
Clay, gray to brown, to red brown, sandy	10	55
Sand, coarse to very coarse, fine gravel, buff to yellow	15	70
Permian Bedrock, shale, red to brick red	10	
10dcc1-Test hole drilled under this project for lithologic purposes, Converted to observation well with 45 feet of 4½ inch PVC well casing slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1060 feet; Bedrock 1015 feet; Water Table 1039 feet.		
Sand, fine, brown to light brown	10	10
Clay, brown, red brown and gray, sandy	10	20
Clay, brown, silty, tough	10	30
Clay, brown	5	35
Clay, dark gray	5	40
Clay, dark gray, soft, some gravel	5	45
Permian Bedrock, clay red to brick red	15	

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN		
10ddl-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1070 feet; Bedrock 1005 feet.		
Sand, fine, light brown, thin clay streak	5	5
Clay, light brown, sandy	5	10
Sand, fine, reddish brown	10	20
Sand, fine, light brown, clayey	10	30
Clay, red brown to brown	10	40
Clay, buff to light brown, silty	7	47
Sand, coarse to very coarse	13	60
Sand, med, reddish color from weathered bedrock	5	65
Permian Bedrock, shale, red to dark red	5	
13dddl-Test hole drilled under this project for lithologic purposes, converted to observation well with 90 feet of 4½ inch PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1090 feet; Bedrock 1001 feet; Water Table 1056 feet.		
Sand, fine to med, light brown to buff	15	15
Sand, fine, buff brown, light gray, silty	5	20
Silt, light brown, gray, clayey	12	32
Sand, med, light brown	2	34
Sand, med to fine, brown to red brown	6	40
Sand, med to very fine, tan	15	55
Sand, very fine, tan; black carbon particles	5	60
Sand, very fine, tan	5	65
Clay, reddish brown, silty, carbonaceous	6	71
Sand, very coarse, fine gravel, tan	18	89
Permian Bedrock, clay, red to maroon, silty	6	
14cbcl-Test hole drilled under this project for lithologic purposes. Converted to observation well with 63 feet of 4½ inch PVC well casing, slotted and gravel packed. Water quality information available. Estimated mean sea level elevations: Land Surface 1070 feet; Bedrock 1009 feet; Water Table 1039 feet.		
Sand, fine to med, brown	5	5
Sand, fine, buff to gray, silty	5	10
Sand, very fine, buff to gray, clayey	25	35

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN		
14cbc1-continued		
Clay, light brown to gray brown, sandy	10	45
Sand, coarse to very coarse, very fine gravel	16	61
Permian Bedrock, shale, red to brick red	2	
18ccc1-Test hole drilled under this project for lithologic purposes. Converted to observation well with 29 feet of 4½ inch PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1050 feet; Bedrock 1022 feet; Water Table 1023 feet.		
Sand, fine to med, light brown to reddish brown	20	20
Sand, coarse, fine gravel, tan	8	28
Permian Bedrock, shale, red to maroon, silty, mottled gray streaks	2	
20aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1026 feet; Bedrock 1001 feet.		
Sand, fine, buff, tan, light brown	15	15
Clay, brown, sandy	5	20
Sand, very coarse, fine gravel	5	25
Permian Bedrock, shale, red to brick red to maroon	10	
22ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1030 feet, Bedrock 998 feet.		
Sand, fine brown to light brown	10	10
Sand, fine to very fine, reddish brown	10	20
Sand, fine, light brown	12	32
Permian Bedrock, shale, red to maroon, hard	4	
27aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1055 feet; Bedrock 1011 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 5 WEST INDIAN MERIDIAN		
27 aaa1-continued		
Sand, very fine to med, reddish brown	5	5
Sand, very fine to fine, red to reddish brown	25	30
Sand, fine, reddish brown to buff brown	10	40
Sand, very coarse, some gravel	4	44
Permian Bedrock, shale, red to brick red	6	
27ddd1-Test hole drilled under this project for lithologic purposes. Converted to observation well with 25 feet of 4½ inch PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1028 feet; Bedrock 1004 feet; Water Table 1020 feet.		
Sand, fine, light brown to buff	10	10
Sand, med, light brown	5	15
Sand, med to coarse, tan	5	20
Sand, very coarse, fine gravel, brown	4	24
Permian Bedrock, shale, red to brick red, gray mottled	6	
TOWNSHIP 17 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
2aaa1-Observation well developed under this project for water level and water quality data. Well cased with 42 feet of 4½ inch PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1120 feet; Bedrock 1073 feet; Water Table 1094 feet.		
Sand, fine to med, brown	5	5
Sand, med to light brown, fine gravel	5	10
Sand, fine, light reddish brown, silty	6	16
Clay, light red brown, sandy	2	18
Sand, fine, light brown	7	25
Sand, fine to very fine, reddish brown	22	47
Permian Bedrock, clay, light brown to reddish brown and red to dark red; with red to maroon, mottled, shale	38	
7aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1080 feet; Bedrock 1046 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
7aaa1-continued		
Sand, fine to med, brown	4	4
Clay, slate gray	1	5
Sand, fine, tan to light brown	10	15
Sand, fine, light reddish brown	8	23
Sand, fine to coarse, tan	11	34
Permian Bedrock, shale, reddish brown to brick red, mottled	11	
9aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1089 feet; Bedrock 1020 feet.		
Sand, fine to med, reddish brown to brown	5	5
Sand, fine to very fine, reddish brown, clay	5	10
Sand, fine reddish brown	15	25
Sand, fine to very fine, reddish brown, clayey	7	32
Clay, reddish brown, and light gray, fossiliferous	4	36
Clay, slate gray, to red brown	12	48
Sand, very coarse, fine gravel, reddish brown (Permian material mixed with gravel)	15	63
Permian Bedrock, shale, red brown to brick red, mottled	7	
10ccb1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1040 feet; Bedrock 1023 feet.		
Sand, fine, dark red	4	4
Siltstone, hard, mottled (Permian red bed--large bolders washed into channel)	2	6
Sand, fine, tan	4	10
Sand, coarse, light brown	7	17
Permian Bedrock, siltstone, red to brick red, shaley, mottled	13	
11ddd1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1070 feet; Bedrock 1026 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
11dddl-continued		
Sand, fine to med, dark brown	5	5
Sand, fine, reddish brown	7	12
Clay, light brown	7	19
Sand, fine to med, brown	1	20
Clay, buff to reddish brown	9	29
Sand, coarse, brown, some fine gravel	15	44
Permian Bedrock, siltstone, red to brick red	6	
12aaa1-Observation well developed under this project for water quality data. Water analysis available. Well cased with 78 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1095 feet; Bedrock 1018 feet; Water Table 1057 feet.		
Sand, fine to med, light brown to brown	4	4
Clay, brown to light brown, sandy	1	5
Clay, gray to light reddish brown, hard, sandy	5	10
Sand, med, light brown to tan, clayey	5	15
Sand, med, light brown to tan	5	20
Sand, med to fine, light brown, to reddish brown	10	30
Clay, light brown to reddish brown, silty	27	57
Sand, med to very coarse	20	77
Permian Bedrock, shale, red to brick red	3	
12bbb1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1097 feet; Bedrock 1014 feet.		
Sand, fine to very fine, reddish brown	6	6
Clay, brown to reddish brown, some light gray sandy clay	18	24
Sand, fine, light brown	9	33
Clay, light brown and gray, sandy	7	40
Clay, light gray, tough	3	43
Sand, fine to very coarse, tan to reddish brown	12	55
Sand, coarse to very coarse, fine gravel, clean, brown	15	70
Sand, coarse, red	13	83
Permian Bedrock, siltstone, red brown, hard, mottled	7	

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
18bcc1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 30 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1013 feet; Bedrock 985 feet; Water Table 1009 feet.		
Sand, fine to med, brown	5	5
Sand, med to coarse, brown	10	15
Sand, med to coarse, gray	10	25
Sand, very coarse, fine gravel	3	28
Permian Bedrock, shale, red to brick red	2	
TOWNSHIP 17 NORTH, RANGE 7 WEST INDIAN MERIDIAN		
2dbd1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 38 feet of 4½ inch PVC well casing slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1023 feet; Bedrock 988 feet; Water Table 1014 feet.		
Sand, med, brown, clayey	8	8
Sand, med to coarse, brown	2	10
Sand, med to coarse, brown, clayey	20	30
Sand, coarse to very coarse, gray with fine gravels	5	35
Permian Bedrock, shale, red to brick red, mottled		
11dba1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 39 feet of 4½ inch PVC well casing slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1025 feet; Bedrock 987 feet; Water Table 1010 feet.		
Sand, fine to med, light brown	10	10
Sand, med to coarse, light brown	10	20
Sand, med to very coarse, fine gravels	18	38
Permian Bedrock, shale, red to brick red	2	
11dcd1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 34 feet of 4½ inch PVC well casing slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1025 feet; Bedrock 994 feet; Water Table 1014 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 17 NORTH, RANGE 7 WEST INDIAN MERIDIAN		
11dcd1-continued		
Sand, med to coarse, light brown	5	5
Sand, med to coarse, buff to tan	10	15
Sand, coarse to med, gray	5	20
Sand, coarse, with fine gravel, gray	11	31
Permian Bedrock, shale, red to bright red	2	
12daa1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 26 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1020 feet; Bedrock 995 feet; Water Table 1007 feet.		
Sand, med to fine, brown	6	6
Clay, brown, sandy	6	12
Sand, med to coarse, brown	13	25
Permian Bedrock, shale, red to brick red, mottled	5	
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
3cbd1-Observation well developed under this project for water level and water quality data. Water analysis available. Installed 36 feet of 4½ inch PVC casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1170 feet; Bedrock 1136 feet; Water Table 1156 feet.		
Sand, fine to med, dark brown	4	4
Clay, dark gray, sandy	2	6
Clay, light gray, sandy	4	10
Clay, light gray, sticky, hard drilling	10	20
Clay, light gray, soft	5	25
Clay, light gray to red to reddish brown	5	30
Clay, gray, silty	4	34
Permian Bedrock, clay, red to maroon, and blue gray, with a mottled red to brick red shale	11	
5ddd1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1172 feet; Bedrock 1134 feet.		
Sand, fine to med, brown to reddish brown	6	6
Clay, gray to varicolored, some sand	7	13

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
5dddl-continued		
Clay, reddish brown with gray streaks, sandy	7	20
Clay, reddish brown	3	23
Sand, fine to very fine, light brown	7	30
Clay, light gray, hard	8	38
Permian Bedrock, clay, red to maroon, green to white mottling	12	
6bbbl-Test hole drilled under this project for water level and water quality data. Installed 45 feet of 4½ inch PVC well casing, slotted and gravel packed. Water analysis available. Estimated mean sea level elevations: Land Surface 1120 feet; Bedrock 1075 feet; Water Table 1096 feet.		
Sand, fine, brown	6	6
Clay, brown, sandy	14	20
Sand, fine to med, brown, clayey	10	30
Sand, fine to med, brown	6	36
Clay, brown	9	45
Permian Redbed, silt, red to dark red, interbedded with red shale, mottled with green to white spots	15	
6dddl-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1153 feet; Bedrock 1120 feet.		
Sand, fine to med, brown to gray	2	2
Clay, slate gray	5	7
Clay, light gray	2	9
Sand, fine to med, red to brown	7	16
Clay, brown to gray, sandy	4	20
Sand, fine to very fine, brown to reddish brown	6	26
Clay, light gray brown	7	33
Permian Bedrock, clay, reddish brown to maroon, mottled	2	
7caal-Observation well developed under this project for water level and water quality data. Water analysis available. Cased with 30 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1150 feet; Bedrock 1118 feet; Water Table 1141 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
7caa1-continued		
Sand, med, light brown with thin clay lenses	8	8
Sand, med, light brown to tan, clean	5	13
Clay, reddish brown	7	20
Clay, light gray, sandy	5	25
Clay, light brown	7	32
Permian Bedrock, shale, red to maroon, mottled	2	
8ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1131 feet; Bedrock 1098 feet.		
Sand, fine to med, dark brown to light brown	5	5
Sand, fine, light brown to red brown, with thin sandy clay lenses and fine gravel	10	15
Sand, fine, light brown to buff, fine gravel	5	20
Sand, fine, silty, light brown to red brown	3	23
Clay, reddish brown	10	33
Permian Bedrock, clay and shale, red to brick red, gummy, mottled	17	
9ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1166 feet; Bedrock 1126 feet.		
Sand, med to fine, reddish brown to light brown	4	4
Sand, fine, light gray, some clay silty	6	10
Sand, med, light brown to tan, some clay	5	15
Sand, med to fine, light brown to red brown with some light brown clay	15	30
Clay, light brown, tough	10	40
Permian Bedrock, clay and shale, red brown to dark red, mottled	10	
10bbb1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1171 feet; Bedrock 1121 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
10bbb1-continued		
Sand, fine to med, dark brown	3	3
Clay, gray, sandy	3	6
Sand, fine to med, light brown to reddish brown	11	17
Clay, light gray, sandy	3	20
Clay, light gray, some red brown with few chunks of sharp gravel	17	37
Sand, fine to med, reddish brown	5	42
Clay, brown	8	50
Permian Bedrock, siltstone, light gray, hard, red to dark red, clay	10	
10ddd1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1174 feet; Bedrock 1121 feet.		
Sand, med, light brown	5	5
Clay, gray, sandy	1	6
Sand, fine, light gray to buff, clean	5	11
Clay, red brown and gray, sandy	6	17
Sand, fine, red brown with some red brown clay	4	21
Clay, brown to light gray, caliche	9	30
Clay, light reddish brown to brown and gray, caliche tough	10	40
Clay, light buff to light gray, caliche	5	45
Clay, light brown to reddish brown	8	53
Permian Bedrock, clay, reddish brown to maroon, gummy, red to maroon, silty and shale	17	
10ddd2-Observation well developed under this project for water level and water quality data. Water analysis available. Installed 57 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1174 feet; Bedrock 1119 feet; Water Table 1160 feet.		
Sand, med to fine, light brown	6	6
Clay, light gray, sandy	3	9
Sand, med, light gray to buff, clean	3	12
Clay, red brown and gray, sandy	8	20
Clay, reddish brown, sandy, caliche	5	25

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
10ddd2-continued		
Clay, light brown to buff and reddish brown, tough	5	30
Clay, yellow, tan, brown, and gray, tough	10	40
Clay, light brown to gray, caliche, gravel pebbles	15	55
Permian Bedrock, clay, reddish brown, gummy, and silty, red shale	6	
15cad1-Observation well developed in this project for water level and water quality data. Water analysis available. Installed 80 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1170 feet; Bedrock 1089 feet; Water Table 1162 feet.		
Sand, dark brown	2	2
Sand, fine, yellow to brown, clayey	3	5
Sand, fine, red brown, with clay layers	5	10
Clay, reddish brown to brown, with sandy gray clay	15	25
Clay, light gray, hard drilling, caliche	5	30
Clay, light gray to reddish brown, caliche	5	35
Clay, light red brown, caliche, sharp edge, pebbles	5	40
Clay, light brown to buff, caliche	20	60
Clay, light brown and buff to gray, sandy, caliche	5	65
Clay, brown to light red brown, gummy	5	70
Sand, fine to very fine, tan to light brown	11	81
Permian Bedrock, shale, red to dark red, hard silty	1	
16aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1170 feet; Bedrock 1090 feet.		
Sand, fine to med, brown	3	3
Clay, dark gray, sandy	2	5
Sand, fine, light gray to buff, clayey	5	10
Clay, gray to red brown	7	17
Sand, fine, red to brown	4	21
Clay, brown	4	25

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
16aaa1-continued		
Clay, red to brown, sandy	8	33
Sand, med to fine, red to brown	34	67
Clay, brown to buff, soft, gummy	13	80
Permian Bedrock, clay, dark brown to reddish brown, shaley, mottled	5	
16ccd1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 64 feet of 4½ inch PVC well casing, slotted, and gravel packed. Estimated mean sea level elevations: Land Surface 1170 feet; Bedrock 1107 feet; Water Table 1138 feet.		
Sand, fine to med, light brown	10	10
Sand, fine, buff to gray, silty	7	17
Sand, fine to very fine, light red brown with thin layers of clay	3	20
Sand, fine to very fine, reddish brown	16	36
Clay, reddish brown sandy	14	50
Clay, reddish brown, tough	13	63
Permian Bedrock, clay, red to dark red	2	
16ddd1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1166 feet; Bedrock 1086 feet.		
Sand, fine to med, brown	4	4
Sand, fine to med, brown and gray, clayey	3	7
Sand, fine, buff to gray	3	10
Sand, fine to med, light brown to reddish brown	10	20
Sand, fine, light brown, thin layer of brown clay	12	32
Clay, light brown, sandy	11	43
Sand, fine, light brown, tan and buff	27	70
Clay, brown, sandy	10	80
Permian Bedrock, clay, red brown, sticky; and red to brick red, shale	20	
17aab1-Observation well developed under this project for water level and water quality data. Water analysis available. Estimated mean sea level elevations: Land Surface 1180 feet; Bedrock 1125 feet; Water Table 1137 feet.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
17aab1-continued		
Sand, fine to med, light brown to light red brown	14	14
Clay, gray, sandy	6	20
Clay, dark gray	5	25
Sand, fine, light brown to yellow, silty	7	32
Sand, med, buff to tan	3	35
Sand, fine, buff to tan, silty	5	40
Clay, light brown to tan to reddish brown	15	55
Permian Bedrock, shale, red to maroon		

17bbb1-Observation well developed under this project for water quality data. Water analysis available. Installed 36 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Bedrock 1094 feet; Land Surface 1130 feet; Water Table 1109 feet.

Formation Description	Thickness	Depth
Sand, med, light brown	5	5
Clay, light brown to yellow brown, silty	5	10
Clay, light brown to reddish brown, silty	5	15
Clay, light brown, red and yellow, sandy	21	36
Permian Bedrock, clay, red to maroon, shaley	4	

17ddd1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1150 feet; Bedrock 1108 feet.

Formation Description	Thickness	Depth
Sand, fine to med, brown	5	5
Sand, fine, light brown, some silt	5	10
Sand, med, light brown to light red brown	5	15
Sand, fine to med, light brown, hard drilling, thin layers clayey sand	9	24
Clay, light brown, buff, yellow, and gray	6	30
Clay, light reddish brown	5	35
Permian Bedrock, shale, red to maroon, mottled	8	

20cca1-Test hole and observation well developed under this project for lithologic purposes and water quality data in the Permian Bedrock. Electric log and water analysis available. Well cased 75 feet deep with 7 inch steel pipe and cemented at bottom. Well completed as open hole from 75 to 140 feet. Estimated mean sea level elevations: Land Surface 110 feet;

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
20cca1- continued		
Bedrock 1043 feet; Water Table 1091 feet.		
Sand, fine, brown	5	5
Sand, fine, reddish brown, some coarse grains	5	10
Sand, fine, reddish brown, silty, carbonaceous	10	20
Sand, very fine, reddish brown, silty	19	39
Clay, reddish brown, soft	1	40
Sand, very coarse, light brown, some fine gravel	10	50
Gravel, fine, few coarse pebbles, coarse sand, shells (fossil is Ferous)	10	60
Sand, med to coarse, brown, tan, and red	7	67
Permian Bedrock:		
Shale, silty, red to maroon, hard	3	70
Shale, red to maroon, soft	5	75
Siltstone, red to maroon, mottled gray	5	80
Siltstone, red to brick red, shaley	5	85
Clay, red to brick red, thin layers of siltstone, mottled gray	15	100
Shale, red to maronn, mottled gray	10	110
Shale, red to brick red, soft	10	120
Shale, red to reddish brown to orange brown, soft; hard layer 125½-126	10	130
Shale, orange brown, mottled white, and greenish gray, soft	5	135
Shale, orange brown, thin layers siltstone	5	140
21ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1113 feet; Bedrock 1049 feet.		
Sand, fine to med, buff and tan to light brown	2	2
Clay, yellow, gray, and brown, sandy	5	7
Sand, fine to med, light brown	3	10
Clay, brown	13	23
Sand, fine to med, reddish brown	13	36
Clay, reddish brown, silty	4	40

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
21cccl-continued		
Sand, fine to very fine, brown	6	46
Sand, med to coarse, clean, brown	4	50
Sand, med to very coarse, fine gravel, brown	14	64
Permian Bedrock, shale, red to maroon	6	
22aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1177 feet; Bedrock 1120 feet.		
Sand, fine to med, brown	3	3
Clay, slate gray	7	10
Clay, light gray, with layers of med to fine sand	5	15
Sand, fine to med, light brown to tan	6	21
Clay, light brown, sandy	16	37
Sand, fine, reddish brown	8	45
Clay, brown, gummy	12	57
Permian Bedrock, clay, red to dark red with gray mottling and red to dark reddish brown, shale	8	
22ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1160 feet; Bedrock 1111 feet.		
Sand, fine to med, tan to buff, clean	20	20
Sand, fine to med, reddish brown	15	35
Sand, fine to silty, reddish brown to brown	6	41
Clay, brown to reddish brown	8	49
Permian Bedrock, clay, red to dark red, mottled, and red to dark red, shale	11	
22cdd1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 52 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1170 feet; Bedrock 1123 feet; Water Table 1127 feet.		
Sand, fine to med, light brown	25	25
Clay, red brown, sandy	15	40

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
22cdd1-continued		
Clay, brown	7	47
Permian Bedrock, clay, red to maroon, mottled	13	
24bbb1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1184 feet; Bedrock 1162 feet.		
Sand, fine, dark brown	3	3
Clay, gray	2	5
Sand, fine, buff to reddish brown	5	10
Sand, fine to med, light brown, clayey	5	15
Sand, fine to med, light brown	7	22
Permian Bedrock, clay, red and gray, and red to dark red, shale	8	
26aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1180 feet; Bedrock 1135 feet.		
Sand, med to very fine, brown to reddish brown	7	7
Sand, med to fine, light brown	8	15
Sand, med to very fine, light brown, some clay	8	23
Clay, light reddish brown, sandy	2	25
Sand, fine to med, light red brown to buff	15	40
Sand, fine, light reddish brown, silty	3	43
Clay, brown to light brown, silty	2	45
Permian Bedrock, clay, red to bright red, mottled, and red to maroon, mottled, silty shale	15	
27ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1122 feet; Bedrock 1085 feet.		
Sand, fine to med, dark brown to red brown	5	5
Sand, fine to med, tan to light brown	12	17
Clay, red brown, sandy	13	30
Clay, red brown, brown, gray; sandy	7	37
Permian Bedrock, clay, red to maroon, soft and dark red, mottled, siltstone	13	

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 4 WEST INDIAN MERIDIAN		
29ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1100 feet; Bedrock 1041 feet.		
Sand, fine to med, dark brown and reddish brown	7	7
Clay, light gray, sandy	4	11
Sand, fine to med, reddish brown	19	30
Sand, fine to coarse, reddish brown, with thin layers of brown clay	5	35
Sand, very coarse, brown, with some fine gravel	15	50
Sand, med to coarse, red to maroon to dark reddish brown	9	59
Permian Bedrock, siltstone, red to brick red, shaley, and mottled	6	
29ddd1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1112 feet; Bedrock 1050 feet.		
Sand, fine to med, light brown	16	16
Clay, gray to yellow gray, sandy	6	22
Sand, fine, light brown	18	40
Sand, med to fine, light brown	9	49
Sand, coarse, and fine gravel, buff to yellow	13	62
Permian Bedrock, shale, red to maroon, with thin siltstone layers, hard, mottled	8	
31baa1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 54 feet of 4½ inch well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1102 feet; Bedrock 1049 feet; Water Table 1082 feet.		
Sand, fine to med, brown	5	5
Sand, very fine, light brown	10	15
Sand, med to fine, light reddish brown	5	20
Sand, fine, reddish brown with yellow gray clay	6	26
Clay, light brown, sandy	3	29
Sand, coarse to very coarse, brown to yellow	27	53

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
31baa1-continued		
Permian Bedrock, shale, red to brick red	3	
31bbb1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 100 feet; Bedrock 1054 feet.		
Sand, fine to med, brown	6	6
Clay, brown to gray, sandy	2	8
Sand, fine to med, light reddish brown; with thin layers of brown clay 8-13 feet.	12	20
Sand, fine to coarse, light reddish brown	5	25
Sand, very coarse, fine gravel, brown	7	42
Permian Bedrock, shale, red to maroon, silty	8	
31ddd1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 34 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1089 feet; Bedrock 1055 feet; Water Table 1082 feet.		
Sand, fine, brown	10	10
Sand, fine, reddish brown, some silt	5	15
Clay, gray to reddish brown, sandy	5	20
Sand, fine, light reddish brown	3	23
Clay, reddish brown	1	24
Sand, fine to coarse, with gravel and thin layers of brown clay	10	34
Permian Bedrock, clay, red to brick red	2	
32baa1-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 70 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1105 feet; Bedrock 1036 feet; Water Table 1087 feet.		
Sand, fine to med, brown	4	4
Clay, dark gray to light gray, sand	2	6
Sand, fine to med, reddish brown	5	11

Table A-5 (continued). LITHOLOGIC LOGS

TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN

32baa1-continued

Formation Description	Thickness	Depth
Clay, gray, gray brown, and tan, sandy	4	15
Clay, buff to gray and red brown, sandy	5	20
Clay, reddish brown to buff, some gray	13	33
Sand, med to coarse, tan, clean	7	40
Sand, med to very coarse, fine gravel, tan to brown, thin layer of reddish brown clay 46-47'	20	60
Sand, fine to med, red, chunks of red clay	9	69
Permian Bedrock, siltstone, red to maroon mottled	1	

32ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1085 feet; Bedrock 1054 feet.

Formation Description	Thickness	Depth
Sand, fine to med, brown	5	5
Sand, fine, light reddish brown	5	10
Sand, fine to very fine, light brown with thin layers gray and brown, sandy clay	10	20
Sand, coarse to very coarse, dark brown	5	25
Sand, med to very coarse, reddish brown	5	30
Sand, med to coarse, light brown with fine gravel	1	31
Permian Bedrock, shale, red to bright reddish brown, silty, mottled	9	

34ccc1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1100 feet; Bedrock 1043 feet.

Formation Description	Thickness	Depth
Sand, fine to med, light brown	5	5
Clay, red brown and light gray, sandy	2	7
Sand, fine to med, reddish brown	3	10
Clay, light gray to blue gray	7	17
Sand, fine to med, tan	12	29
Clay, reddish brown and gray, sandy	6	35
Sand, med to coarse, buff to brown	5	40
Sand, med to very coarse, brown, with thin layers of gray clay	5	45
Sand, med to coarse, tan	5	50
Sand, very coarse, light reddish brown	5	55

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
34cccl-continued		
Sand, very coarse, fine gravel, brown	2	57
Permian Bedrock, siltstone, red brown to brick red	8	
35bbbl-Observation well developed under this project for water level and water quality data. Water analysis available. Well cased with 61 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface 1143 feet; Bedrock 1080 feet; Water Table 1120 feet.		
Sand, fine to med, brown	5	5
Sand, fine, light gray, clayey, some fine gravels	3	8
Sand, fine, light reddish brown	13	21
Clay, light reddish brown, sandy	2	23
Sand, med to fine, reddish brown	13	36
Clay, light brown, red brown, and gray, sandy	27	63
Permian Bedrock, siltstone, red to maroon	1	
35dddl-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1118 feet; Bedrock 1075 feet.		
Sand, fine to med, light red brown	10	10
Sand, fine, light red brown to buff, silty	5	15
Sand, med to fine, light reddish brown	5	20
Clay, brown, sandy	4	24
Sand, fine to med, brown to red brown	19	43
Permian Bedrock, siltstone, red to maroon mottled	7	
36bbbl-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1170 feet; Bedrock 1103 feet.		
Sand, fine to med, brown to tan	10	10
Sand, fine to very fine, reddish brown	3	13
Clay, reddish brown, sandy	9	22
Sand, med to fine, light brown, carbonaceous	13	35

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 18 NORTH, RANGE 6 WEST INDIAN MERIDIAN		
36bbb1-continued		
Sand, med, light brown, clean	17	52
Clay, brown, hard drilling	15	67
Permian Bedrock, clay, red to brick red, soft, some mottling	13	
TOWNSHIP 18 NORTH, RANGE 7 WEST INDIAN MERIDIAN		
35aaa1-Test hole drilled under this project for lithologic purposes, no casing installed. Estimated mean sea level elevations: Land Surface 1080 feet; Bedrock 1033 feet.		
Sand, fine to med, dark brown	6	6
Clay, buff, sandy	4	10
Clay, buff and reddish brown, sandy	10	20
Sand, fine to med, reddish brown	4	24
Clay, buff to gray, sandy	1	25
Sand, very coarse, some gravel reddish brown	15	40
Sand, and gravel, reddish brown to tan	7	47
Permian Bedrock, shale, red to brick red	13	
TOWNSHIP 18 NORTH, RANGE 8 WEST INDIAN MERIDIAN		
10bab-Observation well developed under this project for water level and water quality data. Well cased with 41 feet of 4½ inch PVC well casing, slotted and gravel packed. Estimated mean sea level elevations: Land Surface.		
Sand, fine, brown	7	7
Clay, brown, gray and red, sandy	6	13
Sand, very fine to med, reddish brown	22	35
Sand, coarse, brown	6	41
Permian Bedrock, siltstone, red to maroon, hard	1	
TOWNSHIP 19 NORTH, RANGE 7 WEST INDIAN MERIDIAN		
8dad1-Observation well developed under this project for water level and water quality data. Well cased with 31 feet of 4½ inch PVC well casing, slotted and gravel packed.		
Sand, fine brown clayey	4	4
Clay, red, reddish brown, hard; fine gravel	14	18

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 19 NORTH, RANGE 7 WEST INDIAN MERIDIAN		
8dad1-continued		
Clay, choc. brown, fine gravel	9	27
Sand, fine to coarse, some fine gravel, brown	3	30
Permian Bedrock, clay, light gray and maroon	2	
22aaa1-Observation well developed under this project for water level and water quality data. Well cased with 40 feet of 4½ inch PVC well casing. Estimated mean sea level elevations: Land Surface 1080 feet; Bedrock 1033 feet.		
Clay, dark brown, sandy	5	5
Clay, choc. brown, silty, hard drilling	5	10
Clay, light choc. brown, gummy, soft	11	21
Sand, coarse, dark brown, fossil shells	4	25
Clay, brown, hard	12	37
Sand, med to coarse, light brown	4	41
Permian Bedrock, clay, red to maroon, hard, shaley	6	
TOWNSHIP 19 NORTH, RANGE 8 WEST INDIAN MERIDIAN		
17ccd-Observation well developed under this project for lithologic purposes, and for water level and water quality data. Well cased with 73 feet of 4½ inch PVC well casing, slotted and gravel packed.		
Sand, fine to med, light brown to tan and reddish brown	20	20
Sand, fine to med, reddish brown some coarse sand and pebbles of fine gravel	5	25
Sand, fine, light brown, brown clay	8	33
Clay, light yellow to brown, sandy	5	38
Sand, fine light brown, clayey	2	40
Clay, light gray, brown, yellow and red brown	18	58
Sand, fine to very coarse, tan to light brown	7	65
Gravel, fine, tan to light brown	7	72
Permian Bedrock, siltstone, hard, red, maroon and gray	2	

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 19 NORTH, RANGE 9 WEST INDIAN MERIDIAN		
10cdd1-Observation well developed under this project for water level and water quality data. Well cased with 32 feet of 4½ inch PVC well casing, slotted and gravel packed.		
Sand, fine to med, brown to tan	16	16
Clay, gray, thin layers of fine gravel	4	20
Sand, fine to med, light gray, clayey	4	24
Sand, fine to coarse, light brown, fine gravel	7	31
Permian Bedrock, siltstone, maroon, hard	1	
TOWNSHIP 20 NORTH, RANGE 10 WEST INDIAN MERIDIAN		
1bbb1-Observation well developed under this project for water level and water quality data. Well cased with 71 feet of 7½ inch PVC well casing.		
Sand, fine to med, brown to light brown	7	7
Clay, gray, sandy	5	12
Sand, med to fine, gray, brown and light brown	15	27
Clay, red, yellow, brown, gray, layers of silt and fine sand	9	36
Sand, coarse to very coarse, light brown with fine to med gravel	24	60
Sand, coarse to med, brown to tan	4	64
Sand, coarse to very coarse, with fine to med gravel	6	70
Permian Bedrock, siltstone, dark red to maroon, hard	1	
TOWNSHIP 21 NORTH, RANGE 9 WEST INDIAN MERIDIAN		
6ccc1-Test hole drilled under this project for lithologic purposes, well was converted to observation well for water level and water quality data. Well cased with 135 feet of 4½ inch PVC well casing, slotted and gravel packed.		
Clay, brown, sandy	5	5
Sand, fine, brown	5	10
Sand, fine to very fine, reddish brown	16	26
Permian Bedrock:		
Sand, very fine, clay reddish brown, orange brown	4	30

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 21 NORTH, RANGE 9 WEST INDIAN MERIDIAN		
6ccc1-continued		
Clay, brown to orange brown, hard	10	40
Clay, brown to orange brown and maroon, greenish white fragments	10	50
Clay, red, red brown to maroon, soft, gummy	10	60
Clay, orange brown to red brown, maroon, greenish white flakes	20	80
Clay, reddish brown to maroon, hard, siltstone layers	10	90
Siltstone, reddish brown, orange brown, and maroon, thin soft layers clay, lost circulation at 135 feet	50	140
TOWNSHIP 22 NORTH, RANGE 10 WEST INDIAN MERIDIAN		
31bab1-Observation well developed under this project for water level and water quality data. Well cased with 51 feet of 4½ inch PVC well casing, slotted and gravel packed.		
Sand, fine to med light red brown	20	20
Sand, fine to med, light brown, clayey	11	31
Sand, fine to med, light brown	5	36
Clay, light brown, sandy	3	39
Sand, med to coarse, light brown	3	42
Clay, light brown, yellow and light gray, sandy	3	45
Sand, very coarse, tan to brown	5	50
Permian Bedrock, shale, red to maroon, hard	1	
TOWNSHIP 22 NORTH, RANGE 11 WEST INDIAN MERIDIAN		
23daa1-Observation well developed under this project for water level and water quality data. Well cased with 68 feet of 4½ inch PVC well casing, slotted and gravel packed.		
Sand, fine to med, light brown, orange brown, and red brown	25	25
Clay, light brown, yellow brown, sandy	5	30
Sand, fine to med light yellow to orange brown	10	40
Sand, fine to very fine, light brown	6	46

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 22 NORTH, RANGE 11 WEST INDIAN MERIDIAN		
23daa1-continued		
Clay, light brown, silty and soft	4	50
Clay, light brown, yellow and red brown, caliche	10	60
Gravel, fine to med, angular to subangular, with very coarse sand	5	65
Sand, very coarse with fine to med gravel	2	67
Permian Bedrock, shale, red to maroon	1	
TOWNSHIP 23 NORTH, RANGE 11 WEST INDIAN MERIDIAN		
19daa1-Observation well developed under this project for water level and water quality data. Well cased with 52 feet of 4½ inch PVC well casing.		
Sand, med, brown, fine gravel	6	6
Clay, choc. brown, sandy, some fine gravel	8	14
Sand, med to coarse, tan to light brown	6	20
Sand, fine to coarse, with fine gravel, light reddish brown	12	32
Sand, fine to silty, light brown, some clay, brown	3	35
Sand, med to coarse, tan to light brown	5	40
Sand, coarse to very coarse with fine gravel, light brown	12	52
Permian Bedrock, shale, red to maroon	3	
TOWNSHIP 23 NORTH, RANGE 12 WEST INDIAN MERIDIAN		
29bbb1-Observation well developed under this project for water level and water quality data. Well cased with 30 feet of 4½ inch PVC well casing, slotted and gravel packed.		
Sand, fine, brown to light brown	15	15
Sand, very fine, light brown	5	20
Sand, fine to very fine, reddish brown	8	28
Permian Bedrock, siltstone, red to maroon, greenish white spots, hard	2	
TOWNSHIP 24 NORTH, RANGE 14 WEST INDIAN MERIDIAN		
26ccc1-Observation well developed under this project for water level and water quality data. Well cased with 60 feet of 4½ inch PVC well casing, slotted and gravel packed.		

Table A-5 (continued). LITHOLOGIC LOGS

Formation Description	Thickness	Depth
TOWNSHIP 24 NORTH, RANGE 14 WEST INDIAN MERIDIAN		
26ccc1-continued		
Sand, fine to med, brown, light brown	10	10
Sand, fine, light reddish brown, carbon flakes	6	16
Clay, light brown, gray, yellow, sandy, hard	7	23
Sand, med to fine, light brown, carbon particles	12	35
Sand, fine to very fine, tan to light brown	17	52
Permian Bedrock, clay, brown, reddish brown, maroon, with light greenish gray spots	8	
TOWNSHIP 25 NORTH, RANGE 15 WEST INDIAN MERIDIAN		
29cca1-Observation well developed for this project for water level and water quality data. Well cased with 51 feet of 4½ inch PVC well casing, slotted and gravel packed.		
Sand, fine, brown	6	6
Clay, light gray	3	9
Sand, very coarse, light red brown with fine gravel	11	20
Permian Bedrock, clay, brown, red and maroon, with greenish white spots	3	